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SPECIAL OPERATIONS AERIAL MOBILITY VEHICLE TRAINING SYLLABUS

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December 2013**

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**SPECIAL OPERATIONS AERIAL MOBILITY VEHICLE
TRAINING SYLLABUS**

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TABLE OF CONTENTS

I.	WHY SOAMV?	1
A.	ANTI-ACCESS CAPABILITY GAP	2
	1. Swarming Methodology.....	4
	2. SOAMV Swarming Doctrine	5
B.	IRREGULAR WARFARE CAPABILITY GAP	8
C.	SOAMV PLATFORM CANDIDATES	10
	1. Light-Sport Aircraft Regulations	10
	2. Light-Sport Aircraft Examples.....	13
D.	SPORT PILOT RATING	22
E.	SOAMV OPERATOR CERTIFICATE	23
II.	CIVILIAN FLIGHT TRAINING	27
A.	CIVILIAN FLIGHT TRAINING PROGRAMS	27
	1. King Schools Private Pilot Syllabus	27
	2. Gleim Private Pilot Syllabus	28
	3. Sport Pilot Syllabus: 5500 Feet Flight Training	30
	4. Society of Aviation and Flight Educators Sport Pilot Syllabus	32
	5. Redbird Skyport Private Pilot Program.....	33
III.	SOAMV TRAINING	37
A.	KNOWLEDGE TRAINING	37
B.	KNOWLEDGE TESTING	37
C.	DEMONSTRATED PROFICIENCY TRAINING MODEL: EXPLAIN, SIMULATE, FLY	38
	1. Simulator Training	38
	2. Flight Training	40
D.	FLIGHT TESTING	40
E.	FINAL CERTIFICATION TESTING	41
IV.	CONCLUSION	43
	APPENDIX A. SOAMV OPERATOR’S COURSE SYLLABUS	45
A.	STAGE 1: FLIGHT FUNDAMENTALS	47
	1. Training Day 1: Introduction to Flight.....	47
	2. Training Day 2: Takeoffs & Landings.....	47
	3. Training Day 3: Airport Operations, Takeoffs & Landings.....	48
	4. Training Day 4: Traffic Patterns, Takeoffs & Landings.....	49
	5. Training Day 5: STAGE ONE CHECK RIDE (Pre-Solo Check)	49
B.	STAGE 2: BASIC MANEUVERS AND PROCEDURES	52
	1. Training Day 6: First Solo Flight	53
	2. Training Day 7: Ground Reference Maneuvers	53
	3. Training Day 8: Soft and Short Field Operations	54
	4. Training Day 9: Landing Zone Operations	54

	5.	Training Day 10: Landing Zone Solo Flight.....	55
C.		STAGE 3: CROSS-COUNTRY FLIGHT	55
	1.	Training Day 11: Cross Country Flight.....	56
	2.	Training Day 12: Night Cross Country Flight	57
	3.	Training Day 13: Night Landing Zone Operations	57
	4.	Training Day 14: Solo Cross-Country Flight	58
	5.	Training Day 15: STAGE THREE CHECK RIDE	58
D.		STAGE 4: TACTICAL SKILLS	61
	1.	Training Day 16: Night Vision Goggle Familiarization	62
	2.	Training Day 17: Night Vision Goggle Takeoffs and Landings	62
	3.	Training Day 18: Night Vision Goggle Cross-Country	63
	4.	Training Day 19: Night Vision Goggles & Unattended Landing Zones	63
	5.	Training Day 20: Night Vision Goggle Solo Flight	64
E.		STAGE 5: SOAMV EMPLOYMENT	64
	1.	Training Day 21: Formation Flight (2 Ship)	65
	2.	Training Day 22: Formation Departures and Arrivals (4-Ship) ...	65
	3.	Training Day 23: Formation Flight & Opportune LZ	66
	4.	Training Day 24: Formation Flights & Landing Zones (4 Ship)...	66
	5.	Training Day 25: Night Formation Flight (4 Ship).....	67
F.		STAGE 6: SOAMV DEPLOYMENT	68
	1.	Training Day 26A: Aircraft Assembly, Disassembly, and Cache..	68
	2.	Training Day 26B: Flight Envelope Awareness	69
	3.	Training Day 27: Full Mission Profile 1—Insert the Force	69
	4.	Training Day 28: Full Mission Profile 2—Extract the Force	70
	5.	Training Day 29: Full Mission Profile 3—Combat Search & Rescue.....	71
	6.	Training Day 30: SOAMV Operator Validation Exercise.....	71
		LIST OF REFERENCES	77
		INITIAL DISTRIBUTION LIST	81

LIST OF FIGURES

Figure 1.	Complete Light-sport Aircraft in Shipping Container	6
Figure 2.	Light-sport Aircraft Landing on Cargo Ship.	7
Figure 3.	ParaJet SkyRunner Powered Parachute Light-Sport Aircraft/ATV.....	14
Figure 4.	ParaJet SkyRunner Short Field Take-Off.	14
Figure 5.	ParaJet Skyrunner in Flight.....	15
Figure 6.	NorthWing Scout XC Apache Light-Sport Aircraft.	16
Figure 7.	NorthWing Scout SC Apache Light-Sport Aircraft.....	16
Figure 8.	Just Aircraft, Highlander Light-Sport Aircraft	17
Figure 9.	Cub Crafters Carbon Cub SS STOL LSA on Amphibious Floats.	18
Figure 10.	Just Aircraft Highlander Super-STOL.	18
Figure 11.	Icon Aircraft A5 Amphibious Light-Sport Aircraft.....	19
Figure 12.	Icon Aircraft A5 Wing Fold.....	19
Figure 13.	Icon Aircraft A5 Off Airport Capability	20
Figure 14.	Multi-Mission LLC, Multi-Mission Aircraft (MMA) with WESCAM MX- 15 Gimbal with Electro-optical and Infra-Red Cameras	21

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LIST OF TABLES

Table 1. Light-Sport Aircraft Performance Comparison21

Table 2. SOAMV Currency Requirements25

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LIST OF ACRONYMS AND ABBREVIATIONS

AFSOC	Air Force Special Operations Command
ASTM	American Society for Testing and Materials
CFR	code of federal regulations
DSG	defense strategic guidance
FAA	Federal Aviation Administration
IW	irregular warfare
JOAC	joint operational access concept
LSA	light-sport aircraft
MMA	multi mission aircraft
SEAL	sea air land (Naval Special Warfare operators)
SOAMV	special operations air mobility vehicle
SOF	special operations forces
SOVE	SOAMV operator validation exercise
STOL	short take-off and landing
USAF	United States Air Force
USSOCOM	United States Special Operations Command
WSC	weight shift control

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I. WHY SOAMV?

Special Operations Forces (SOF) use an impressive array of aerial infiltration and exfiltration options. They can parachute from specialized MC-130 Combat Talon aircraft designed to penetrate into high-risk airspace, cover impressive distances in state-of-the-art CV-22 Osprey Tilt-Rotor aircraft, or hug the nap of the earth with specially trained 160th Special Operations Aerial Regiment crews flying MH-60 Blackhawks. Do SOF need one more insertion platform?

The airframes listed above, and all of the air vehicles available to SOF, are variations on a single theme: Put a team in a metal can with a professional aircrew at the controls. This arrangement works well for the majority of SOF missions, but also induces significant risk to the mission; one lucky shot can cause mission failure. For instance, on 6 August 2011, a U.S. Boeing CH-47 Chinook helicopter, call sign Extortion 17, was shot down in Afghanistan, resulting in complete mission failure and the loss of an irreplaceable national asset—an entire troop of our most elite Navy SEALs.

Special Operations Air Mobility Vehicles (SOAMVs) represent an opportunity to distribute risk across a special operations team to dramatically reduce the risk to mission. They provide a unique capability that is complementary to current aerial platforms, but have significant advantages in certain mission sets. Using simple aircraft with the right blend of technology and innovative tactics, special operators could achieve decisive tactical advantages in specific threat environments.

The SOAMV concept is platform agnostic, but is based on ground special operators flying Light-sport aircraft. The Federal Aviation Administration created this unique category of aircraft in 2004 to encourage manufacturers to produce safe, simple aircraft with limited capabilities and performance to simplify the flight experience. The aviation industry responded vigorously with an explosion of new designs featuring incredible capabilities. (A brief discussion on some promising designs follows in Section C).

Light-sport aircraft are limited to two occupants, so the traditional practice of using professional pilots would require a 1:1 pilot to operator ratio. Alternatively, if traditionally ground-based operators (e.g. Special Tactics, Special Forces, SEALs) could be taught to operate these simple aircraft, professional SOAMV pilots would not be required. Given the extraordinary level of training already invested in special operations aircrews, it seems prudent to keep these airmen in their specialized platforms and train ground operators to employ SOAMVs as a complementary capability. The SOAMV concept rests on the ability to teach select special operators to fly these aircraft. This thesis proposes procedures to accomplish that training safely and in a surprisingly reasonable amount of time.

A. ANTI-ACCESS CAPABILITY GAP

Special Forces Major David Kenney's December 2012 Naval Postgraduate School thesis, "Air Mobility Vehicles: Special Operations' Answer to Opposed Access," argues that special operations forces will continue to face significant access challenges in denied areas as our enemies innovate to defend against dominant air power. Major Kenney presents the SOAMV concept as a potential material solution to requirements levied by the 2012 Defense Strategic Guidance (DSG) and Joint Operational Access Concept (JOAC).¹ Indeed, SOAMV's unique design could add tremendous capability to Special Operations Forces if used in concert with revolutionary employment doctrine under the guidance of a bold, coherent strategy.

Major Kenney presents compelling data regarding the low-visibility of weight shift control aircraft to radar, thermal, and acoustic sensors and suggests that these light aircraft could penetrate sophisticated integrated air defense networks. As evidence, he cites headlines from the United States showing drug networks moving thousands of pounds of illicit materials across the Mexican border via small aircraft and Iranian smuggling networks penetrating United States-controlled Iraqi airspace with dangerous cargoes of explosively formed penetrators on weight shift control aircraft. Despite

¹ David Kenney, "Air Mobility Vehicles: Special Operations' Answer to Opposed Access" (Master's thesis, Naval Postgraduate School, 2012).

enormously expensive operations to identify and intercept the aircraft, the United States did not prove able to detect most aircraft from Iran and remains largely ineffective against drug networks employing similar aircraft to enter the United States.²

Special operations could employ light aircraft to exploit this same vulnerability in opposed access environments. SOAMV aircraft could elude air defense systems by exploiting gaps in coverage, gaps that would be larger for SOAMV aircraft than large cargo variant aircraft like MC-130s because SOAMVs have smaller radar, thermal, visual and audible signatures, and are more difficult to detect at a distance. SOAMV's slow speed and maneuverability enable excellent terrain masking which can help prevent remote sensing.

SOAMV aircraft present an undeniable advantage when low visibility is required. When operating in delicate political environments where a large U.S. footprint is counterproductive, these light aircraft could bring incredible capabilities to a team with a very small operational and logistical footprint. Additionally, these small aircraft could be dispersed at several operating locations to lower our operator's signature further.

In many tactical situations, a ramp full of U.S. military aircraft would tip our hand and put SOF at a disadvantage. One example is a hostage rescue in a remote country with a significant early warning network. Moving a fleet of MH-60 Blackhawks into an inland country in Africa, for instance, is logistically extremely difficult, and virtually impossible to accomplish covertly due to robust intelligence networks in the region. Alternatively, moving a fleet of SOAMVs into the country could be as simple as crating them up in storage containers and shipping them. Or, a large cargo aircraft could fly non-stop from Europe or the United States and air-drop SOAMVs into a suitable area like a dry lake bed, and the hostage rescue team could parachute out after them, assemble their aircraft, and fly to an offset location near the target. Once the mission is complete, the SOMAVs would give the team the ability to extract themselves and the hostages to a safe area or seized airfield for pickup by long-range cargo aircraft.

² Kenney, "Air Mobility Vehicles."

SOF aviation is an extremely valuable and specialized asset. In many cases, there is just not enough air support to go around. Some operating locations simply do not have enough troops on the ground to justify dedicated air support from these prized, limited assets. Yet, if a small team had just one SOAMV-certified individual, operators could travel into their area with their own aircraft and they would have dedicated (yet limited) logistical support, medical evacuation, search and rescue, reconnaissance capabilities, as well as the ability to bypass typical threats on roads (e.g., bandits, corrupt checkpoints, kidnapping teams, ambushes, and improvised explosive devices, to name a few). If special operations are moving away from large fortress-like operations that typified Iraq and Afghanistan, and towards more distributed, smaller operations, it seems prudent to devise a plan now to support those small, dispersed units with air assets. SOAMVs may be a significant part of that solution.

1. Swarming Methodology

Employing SOAMVs using swarming doctrine may also provide a partial answer to the limited anti-access problems identified by the Joint Operational Access Concept.

Swarming is a seemingly amorphous, but deliberately structured, coordinated, strategic way to perform military strikes from all directions... It will work best—perhaps it will only work—if it is designed mainly around the deployment of myriad, small, dispersed, networked maneuver units.³

The SOAMV is built to swarm. Its high mobility provides an excellent platform for a networked force to maintain individual autonomy while coordinating complex pulsing operations; the low cost of SOAMV vehicles enables fielding them in large numbers; existing military communication data-link technology can connect the swarm into a robust, encrypted mesh network; a mesh network could allow on-the-fly coordination and information sharing between all elements in the cluster.⁴

³ John Arquilla and David Ronfeldt, introduction to “Swarming and the Future of Conflict,” (Santa Monica, CA: RAND Corporation, 2000), http://www.rand.org/pubs/documented_briefings/DB311, vii.

⁴ John Arquilla and David Ronfeldt, “Swarming and the Future of Conflict” (Santa Monica, CA: RAND Corporation, 2000), http://www.rand.org/pubs/documented_briefings/DB311, 87.

2. SOAMV Swarming Doctrine

Future SOAMV operators should research, test, and codify employment doctrine for SOAMV operations. Since these air vehicles present entirely new capabilities (but also have their limitations) operators must undertake a significant design effort to maximize the relative advantage of the SOAMV in different threat environments and missions.

“BattleSwarm” doctrine provides an excellent starting point for SOAMV tactics. Instead of typical tight airborne formations to maximize the defensive electronic warfare coverage, SOAMVs could depart from different places at different times and fly odd, deceptive patterns until converging—or “pulsing”—into a particular location for mass effects. Each SOAMV operator could autonomously determine his or her optimal flight path to take advantage of terrain and avoid threats. Following the mission, these individual aircraft could depart the area and immediately disperse on separate escape routes.⁵

If the area of operations contains regular air traffic—as it would in many South American locations—SOAMV aircraft would be able to join normal air traffic on apparently typical light aircraft sorties and not raise suspicion in the same way a flight of military aircraft would. At a given signal, the SOAMV “swarm” could break out of normal traffic and converge on the target area with very little prior warning.

SOAMV tactics should include integration with current USAF and Special Operations air capabilities to encourage complementary and synergistic effects. Where applicable, SOAMV aircraft could receive video feeds, target updates, threat avoidance data, electronic warfare support, and communications relays from existing assets. The low visibility of SOAMVs makes them an excellent choice for reconnaissance missions in small numbers.

The ability to field a large number of SOAMVs makes them ideal for search operations and some candidate airframes have the cargo capacity to perform limited rescue operations. SOAMV aircraft have the ability to fly low and slow over a search

⁵ Arquilla and Ronfeldt, “Swarming,” 76.

area, and most provide excellent visibility of the terrain below. Despite its slow speed, a SOAMV detachment could search a large area quickly and efficiently through its ability to operate en masse. Clearly, this tactic would only be suitable for a threat environment that would permit low, slow flying aircraft flying predictable routes and is in no way a replacement for a heavily armed combat search and rescue task force (CSARTF). However, where a CSARTF is not available, SOAMVs could save lives.

The SOAMV stable could include multiple types of aircraft so that tacticians would have even more opportunities for deception and surprise. The small, portable nature of many potential SOAMV aircraft makes it feasible to move aircraft quietly into position near the target area using common freight transportation (via shipping containers—[see Figure 1], cargo aircraft, trucks, palletized airdrops, etc.).⁶



Figure 1. Complete Light-sport Aircraft in Shipping Container

Potential SOAMV airframes can also launch as a swarm from lakes, coves, dirt roads, airstrips, highways, parking lots, lakebeds, meadows, or any number of other

⁶ Some models feature wings that fold at the push of a button to enable rapid return to service after shipping. Other models require basic hand-tools and may be assembled by pilots in 15–30 minutes.

locales to include from a cargo ship, as depicted in Figure 2.⁷ In fact, flat top ships could be employed to launch Marine special operations forces on unique “*over-the-beach*” raids.



Figure 2. Light-sport Aircraft Landing on Cargo Ship.⁸

The SOAMV should be particular welcome for certain kinds of Air Force Special Operations missions. The Air Force Special Operations Command website describes a Combat Controller as a, “trained FAA air traffic controller who deploys first into hostile or denied territory to survey and secure assault and landing zones. They can guide in military aircraft or direct precision attack from fighters and bombers.”⁹ The current template for securing Landing Zones, as described in Air Force Instruction 13–217, calls

⁷ Operations as depicted in Figure 2 require advanced piloting skills, and are intended primarily to demonstrate the capabilities of the aircraft. Landings at sea require extensive additional training that is beyond the scope of the Primary Flight Training discussed in this project.

⁸ From Sarah Deneer, “Small airplane lands on cargo ship, cameras rolling,” Aircraft Owners and Pilot’s Association, accessed November 3, 2013, http://www.aopa.org/News-and-Video/All-News/2013/November/07/cargo-ship-landing.aspx?WT.mc_sect=tts&WT.mc_id=131108epilot.

⁹ “Special Tactics,” The Official website of Air Force Special Operations Command, accessed November 9, 2013, <http://www.afsoc.af.mil/specialtactics>.

for Combat Controllers to be airdropped into a location to survey a potential airfield for suitability. Once the airfield is deemed suitable by the team, then large cargo aircraft can land, insert mission forces, and extract mission forces to include the Combat Control Team. If a Combat Control Team jumps into an airfield that is unsuitable, however, its extraction options are very limited.

Alternately, if such a team were equipped with SOAMVs, then, once in the target area, it could easily land and assess multiple potential landing areas in a short amount of time (security environment permitting) and select the best site to bring in cargo aircraft. If no suitable sites are found, or the mission is delayed, the team could self-extract to a safe area for pickup.

The concepts listed in no way represent a comprehensive list of employment techniques, but merely a starting point for future innovation. Future research is needed to develop and codify SOAMV employment doctrine.

B. IRREGULAR WARFARE CAPABILITY GAP

During the 2010 Quadrennial Defense Review, the United States Air Force (USAF) identified a significant gap in its ability to conduct Irregular Warfare training with partner nations. The Secretary of Defense agreed, and tasked the USAF to field light mobility and light attack aircraft to increase its ability to partner with other nations.¹⁰ The USAF understands that, “many [Partner Nations] cannot afford, fly, or sustain current USAF weapons systems.”¹¹ Air Force Special Operations (AFSOC) Major’s Week and Winter note in their 2012 Naval Postgraduate School thesis, “[w]hile numerous allied nations possess skilled and ready ground SOF components, relatively few possess special operations aviation capabilities. This lack is largely due to the prohibitively high costs of acquiring and maintaining such specialized niche aircraft.”¹²

10 U.S. Department of Defense. *Quadrennial Defense Review Report*, February 2010, 29.

11 United States Air Force, *Irregular Warfare Strategy*, 2013. D-2

12 Martin W. Week, III, Walter M. Winter, “Special operations forces aviation on a shoestring budget: an effectiveness analysis of light and medium fixed wing aircraft” (Master’s thesis, Naval Postgraduate School 2012).

By comparison, SOAMV aircraft are unbelievably inexpensive to purchase and operate. The SOAMV alternatives presented in Section I, Paragraph C of this thesis range from \$45,000 to \$200,000 each; most operate on four to six gallons of fuel per hour and can be repaired with simple hand tools. While Light-sport aircraft engines typically run on unleaded automotive gas, most airframes will support a wide variety of engine options that run on aviation fuel, diesel, kerosene, jet fuel, or even electricity.

For instance, in 2009, Brazil purchased four UH-60 Blackhawks (basic utility versions of the specialized MH-60 that SOF uses) for \$15,100,000 each. These aircraft each burn about 180 gallons of jet fuel per hour and require a complex logistics and mechanical support network to remain airworthy.¹³ In fairness, a SOAMV cannot do what a Blackhawk can, but for less than \$1 million (U.S), we could equip our partner Special Operations Forces with the ability to unilaterally move a small team by air. For many nations, this would be a game-changer given their security challenges. As discussed later in this thesis, some of SOAMV airframes are easily modified to conduct airborne Intelligence, Surveillance, and Reconnaissance—which renders them even more useful for our SOF partners on a very modest budget.

As it is, the USAF's irregular warfare strategy stipulates, "[t]he purchase of a handful of very basic, inexpensive "off-the-shelf" light aircraft to be attached to existing advisory units; novel partnerships with contract service providers or civilian agencies to allow Airmen to gain and maintain proficiency in light aircraft in an internal security role"¹⁴ USSOCOM could follow a similar strategy and procure SOAMV aircraft, while, at the same time seeking opportunities to partner with industry to achieve efficiencies in procurement and operation. According to USAF IW strategy, the Air Force is already heading in this direction. "The USAF will establish a creative, effective, and affordable way to enhance its ability to develop [Partner Nation] air forces that use light aircraft."¹⁵ If so, USSOCOM should watch with interest as the USAF learns lessons through the procurement, training, and employment process. The USAF will likely select aircraft that

13 "Sikorsky S-70," All the World's Aircraft. Jane's Defence. 27 Feb 2013.

14 United States Air Force, Irregular Warfare Strategy, 2013, 17.

15 United States Air Force, Irregular Warfare Strategy, 2013. 17.

split the difference between SOAMVs and current USAF inventory in terms of cost and performance, but it will undoubtedly also tread new ground in procuring and operating simple, off-the-shelf aircraft.

C. SOAMV PLATFORM CANDIDATES

The SOMAV concept does not rely on a single airframe type. As mentioned previously, the concept rests on the use of Light-sport aircraft by ground special operators. The following sections provide a brief description of Light-sport aircraft as well as a few notable examples. These examples are intended to orient readers to a few of the unique designs emerging in general aviation and spur future research in potential design improvements or special modifications.

1. Light-Sport Aircraft Regulations

The Federal Aviation Administration (FAA) issued LSA regulations in 2004 to make flying more accessible by certifying safe, simple aircraft that could be flown by part-time pilots. The regulations specifically capped the performance and complexity of these aircraft to enable a simplified pilot rating called the Sport Pilot. FAA standards forbid complicated systems such as variable propellers and retractable landing gear and require docile and linear flight characteristics. Many LSA designs include full-airframe parachutes that can be deployed as a last resort to bring the aircraft, occupants, and payload safely to the ground.

According to the FAA's General Aviation and Part 135 Activity Surveys–CY 2010, Americans flew 140,000 hours in Light-sport aircraft and had safety records similar to those of pilot's flying more complex airplanes certified under Part 23 of FAA

Regulations.¹⁶ This is an impressive record considering that seasoned pilots operate most aircraft certified under Part 23, while part-time hobby pilots operate a significant majority of Light-sport aircraft.¹⁷

The FAA specifically defines the operating limits and capabilities of Light-sport aircraft in Title 14 of the Code of Federal Regulations using the following language.

Light-sport aircraft means an aircraft, other than a helicopter or powered-lift that, since its original certification, has continued to meet the following:

- (1) A maximum takeoff weight of not more than—
 - (i) 1,320 pounds (600 kilograms) for aircraft not intended for operation on water; or
 - (ii) 1,430 pounds (650 kilograms) for an aircraft intended for operation on water.
- (2) A maximum airspeed in level flight with maximum continuous power (VH) of not more than 120 knots CAS under standard atmospheric conditions at sea level.
- (3) A maximum never-exceed speed (VNE) of not more than 120 knots CAS for a glider.
- (4) A maximum stalling speed or minimum steady flight speed without the use of lift-enhancing devices (VS1) of not more than 45 knots CAS at the aircraft's maximum certificated takeoff weight and most critical center of gravity.
- (5) A maximum seating capacity of no more than two persons, including the pilot.
- (6) A single, reciprocating engine, if powered.
- (7) A fixed or ground-adjustable propeller if a powered aircraft other than a powered glider.
- (8) A fixed or auto-feathering propeller system if a powered glider.
- (9) A fixed-pitch, semi-rigid, teetering, two-blade rotor system, if a gyroplane.

¹⁶ United States Department of Transportation, Federal Aviation Administration.
http://www.faa.gov/data_research/aviation_data_statistics/general_aviation/CY2010/.

As of the writing of this document, the FAA has not released any data sets beyond 2010, citing “recalibration issues.”

¹⁷ Thomas P. Turner, “Is The LSA Safe?” Aviation Safety Magazine, August 2012,
http://www.aviationsafetymagazine.com/issues/32_8/features/is-the-lsa-safe_10334-1.html.

- (10) A non-pressurized cabin, if equipped with a cabin.
- (11) Fixed landing gear, except for an aircraft intended for operation on water or a glider.
- (12) Fixed or retractable landing gear, or a hull, for an aircraft intended for operation on water.
- (13) Fixed or retractable landing gear for a glider.¹⁸

Most General Aviation Aircraft conform to an extremely rigid set of limitations listed under 14 CFR Part 23. The FAA must certify that a particular design is in compliance before the aircraft can be marketed or sold. This certification process is extraordinarily comprehensive and expensive. A typical single-engine, four-seat, light aircraft requires about ten to fifteen years and \$60,000,000–\$100,000,000 of research and testing to be certified under Part 23.¹⁹

In contrast, the FAA engaged LSA stakeholders to assist in developing a set of mutually accepted standards that would be enforced by the FAA. The result was a set of common sense standards that are continually updated and maintained by the American Society for Testing and Materials (ASTM) International.

Established in 1898, ASTM International provides a global forum for the development and publication of international voluntary consensus standards for materials, products, systems and services. Known for their high technical quality and market relevance, ASTM standards are used in research and development, product testing and quality systems.²⁰

Aircraft manufacturers are free to develop new designs as long as they prove that they meet or exceed ASTM Standards through occasional FAA audits. This new approval process ignited an explosion of innovation in aircraft design. Globally, manufacturers

¹⁸ 14 Code of Federal Regulations, Subchapter A, § 1.1 General definitions.
<http://www.gpo.gov/fdsys/pkg/CFR-2008-title14-vol1/pdf/CFR-2008-title14-vol1-sec1-1.pdf>.

¹⁹ Robert Goyer, “Part 23: Time for a Change,” Flying Magazine, Apr 27, 2013,
<http://www.flyingmag.com/pilots-places/pilots-adventures-more/part-23-time-change#LwT0i09eTI5Muffg.99> <http://www.flyingmag.com/pilots-places/pilots-adventures-more/part-23-time-change>.

²⁰ “ASTM Fact Sheet,” ASTM website, November 2013,
<http://www.astm.org/ABOUT/factsheet.html>

registered 123 LSA models for sale in the United States since the regulations were introduced in 2004.²¹ In the same time period, the FAA certified five new aircraft designs under Part 23.²²

2. Light-Sport Aircraft Examples

LSAs come in an extraordinary range of designs and capabilities. According to FAA rules, a sport pilot may operate any of these aircraft once he or she receives training in each different type. These aircraft have vastly different capabilities and handling characteristics, but most share similar engines. A few major categories that may be candidates for the SOAMV program include Powered Parachute, Weight Shift Control, Composite, STOL, and Amphibious aircraft.

a. Powered Parachute

Powered parachute LSAs consist of a vehicle or harness with a reciprocating engine suspended from a Ram-Air Canopy. They can usually accommodate a significant payload, but suffer from a limited range due to its comparatively slow cruise speeds. These aircraft are very sensitive to wind and poor weather, giving them a small envelope for operational use. The Parajet Skyrunner in Figures 3–5 has the ability to travel up to 115 mile per hour overland; it can transition very quickly from air to ground, as required by the mission, and is very transportable due to its collapsing wing.²³

²¹ John Croft, “Updated Part 23 Rules To Revive Four-Seat GA Market,” Aviation Week and Space Technology, July 29, 2013. http://www.aviationweek.com/Article.aspx?id=/article-xml/AW_07_29_2013_p48-599438.xml&p=1.

²² John Croft, “Updated Part 23 Rules.”

²³ “SkyRunner Specifications,” ParaJet Corporation, accessed November 1, 2013, <http://www.fly-skyrunner.com>.



Figure 3. ParaJet SkyRunner Powered Parachute Light-Sport Aircraft/ATV²⁴



Figure 4. ParaJet SkyRunner Short Field Take-Off. ²⁵

24 From “SkyRunner Design,” ParaJet Corporation.

25 From “SkyRunner Design,” ParaJet Corporation.



Figure 5. ParaJet Skyrunner in Flight. ²⁶

b. Weight Shift Control

Weight shift control (WSC) aircraft are two seat trikes suspended from a semi-rigid wing. These aircraft can include semi-enclosed fairings, as illustrated in Figure 6, to partially shield the occupants from the elements and are routinely outfitted with advanced “glass cockpit” navigation and communication systems. WSC aircraft have interchangeable wings to maximize specific flight characteristics; larger wings typically allow for a larger usable load, while smaller wings, like the one shown in Figure 7, boost speed and range. WSC aircraft are typically inexpensive and many include an optional ballistic (rocket deployed) parachute for enhanced safety. Some of these aircraft are outfitted with soft, flotation style tires and rugged suspension to allow for landings in austere, unprepared surfaces. WSCs strike a good balance between ease of operation and operational utility.

²⁶ From “SkyRunner Design,” ParaJet Corporation.



Figure 6. NorthWing Scout XC Apache Light-Sport Aircraft.²⁷



Figure 7. NorthWing Scout SC Apache Light-Sport Aircraft.²⁸

²⁷ From "Scout XC," North Wing Corporation, accessed October 15, 2013, <http://www.northwing.com>.

²⁸ From "Scout XC," North Wing.

(1) Short Takeoff and Landing (STOL) LSA's. STOL LSAs are remarkably capable aircraft (Figure 8). These aircraft boast some of the largest available payloads for LSA while sporting impressive speeds and ranges. The most unique feature of these aircraft is in the ability to land and take off in rough terrain. This type of flying requires additional training for those seeking to become truly proficient.



Figure 8. Just Aircraft, Highlander Light-Sport Aircraft²⁹

Some STOL LSA designs can be outfitted with floats for amphibious operations (Figures 9 and 10). The FAA allows sport pilots to train and test in land, water, or amphibious aircraft, but switching between categories requires additional training.³⁰ For instance, a sport pilot that begins training on land aircraft requires about five hours of flight training to meet the FAA's required Practical Test Standards for water operations.³¹

²⁹ From "Highlander STOL," Just Aircraft Company, accessed October 1, 2013, <http://www.justaircraft.com>

³⁰ FAA-S-8081-29 SPORT PILOT Practical Test Standards, United States Department of Transportation, Federal Aviation Administration, December 2004, http://www.faa.gov/training_testing/testing/test_standards/media/faq-s-8081-29.pdf.

³¹ Jack Brown's Seaplane Base website, accessed November 1, 2013, <http://brownsseaplane.com>. Jack Brown is a recognized industry leader in Seaplane training. He has trained over 17,000 seaplane pilots at his Florida based Brown's Seaplane Base.



Figure 9. Cub Crafters Carbon Cub SS STOL LSA on Amphibious Floats.³²



Figure 10. Just Aircraft Highlander Super-STOL.³³

³² From "Amphibious," Cub Crafters, LLC, accessed November 13, 2013, http://www.cubcrafters.com/images/media/ccss_amphibs_01.jpg

³³ From "Highlander STOL," Just Aircraft Company.

(2) Amphibious LSAs. Amphibious LSAs have the ability to operate on land or on the water. Icon's A5 (Figures 11 and 12) is a notable example of the type. This two seat composite aircraft is designed with a cutting edge human interface to make the flight experience safer, simpler, and more intuitive.



Figure 11. Icon Aircraft A5 Amphibious Light-Sport Aircraft³⁴



Figure 12. Icon Aircraft A5 Wing Fold³⁵

34 From "Images: Icon Aircraft, accessed November 14, 2013, <http://www.iconaircraft.com>.

35 From "Images: Icon Aircraft.

The A5 is designed with wings that fold with the touch of a button to allow transport by boat trailer. This feature would make it simple to rapidly transport numerous aircraft to an area of operations by air, land, or sea. The A5 can operate from a runway, road, dirt/grass strip, dry lake bed (see Figure 13), or a suitable body of water.



Figure 13. Icon Aircraft A5 Off Airport Capability³⁶

(3) Composite Light-sport aircraft—Jabiru J430. Jabiru is an Australian company that exports an aircraft called the J230 as a Light-sport aircraft. The same aircraft is available in Australia as a four seat aircraft called the J430. Due to the LSA restriction of two occupants, only the J230 is available in the United States under the light-sport category.³⁷ As a result, the airframe and engine are designed to handle much higher loads than most LSAs; this excess capacity turns it into one of the best performing aircraft in the category.

The aircraft shown in Figure 14 has been modified to serve in an Intelligence Surveillance and Reconnaissance role with the addition of a WESCAM MX-15 sensor and mission equipment that provides real-time tracking and location data to the mission equipment operator. This aircraft also provides live video downlink and secure communications with other aircraft and ground users. While it is beyond the scope of the

³⁶ From “Images: Icon Aircraft.

³⁷ From “J230,” Jabiru USA, Inc., accessed Jun 1, 2013, <http://JabiruUSA.com>.

The J430 is available in the United States as a kit. When assembled, these aircraft are operated in the amateur-built experimental category or the public-use category.

SOAMV program to operate sophisticated sensor suites like the ones pictured in Figure 15, similarly equipped aircraft could join a SOAMV “swarm” to provide crucial intelligence, command & control, landing zone selection, and/or threat identification.



Figure 14. Multi-Mission LLC, Multi-Mission Aircraft (MMA) with WESCAM MX-15 Gimbal with Electro-optical and Infra-Red Cameras³⁸

The performance specifications of the preceding aircraft vary considerably; each aircraft has been designed to maximize particular features while compromising others. Table 1 lists critical performance data for all of these aircraft for direct comparison.

Table 1. Light-Sport Aircraft Performance Comparison

³⁸ “Multi Mission Aircraft,” Multi Mission Limited Liability Corporation, accessed June 1, 2013, <http://multimissionllc.com>.

Aircraft	Price	Seats	Payload (Lbs)	Range (NM)	Takeoff/Landing Distance (ft)	Cruise Speed (Kts)	Notes
NorthWing Apache XC	\$55K	2	490	335	780	65	Soft, folding wing
ParaJet Sky Runner	\$118K	1	500	200	100	55	Collapsing wing (Parachute)
Just Acft Highlander	\$60K	2	705	480	150	110	Extreme off-airport capability
Icon A5	\$189K	2	450	300	750	105	Amphibious. Self folding wings
Multi-Mission Aircraft (Jabiru 430)	\$143K	4	500	800	650	120	Price and performance numbers are for “slick” version. ISR equipment extra

D. SPORT PILOT RATING

The FAA introduced the sport pilot rating to accompany the rollout of the LSA category. Sport pilots require half of the training required of private pilots, but can only operate Light-sport aircraft. This difference in training is a direct result of the simplicity of LSAs, but comes with additional limitations. Sport pilots are not authorized to fly in bad weather, or for hire.³⁹

In the civilian sector, sport pilots begin their training by passing a standardized written knowledge test. After the knowledge test, they must train for a minimum of fifteen hours with a certified instructor pilot and accumulate five hours of solo flight.

³⁹ “Student Pilot Certificate Procedures and Sport Pilot Endorsements,” United States Department of Transportation, Federal Aviation Administration, March 2010, http://www.faa.gov/licenses_certificates/airmen_certification/sport_pilot/media/student_pilot%20guidance.pdf.

Two hours must be cross-country flight training. The student must log 10 takeoffs and landings to a full stop (with each landing involving a flight in the traffic pattern) at an airport. The student must conduct one solo cross-country flight of at least 75 nautical miles total distance, with a full stop landing at a minimum of two points and with one segment of the flight consisting of a straight-line distance of at least 25 nautical miles between the takeoff and landing locations. Within 60 days of taking the practical test, the student must fly with an instructor for three hours and work exclusively on test preparation.⁴⁰ Upon passing their practical flight test, or “Check Ride,” a sport pilot may operate light-sport aircraft alone or with a passenger.

E. SOAMV OPERATOR CERTIFICATE

SOAMV Operators will have many of the same training requirements as Sport Pilots, but will also need training in night operations, night vision goggle use, military airspace procedures, integration with military flight operations, employment doctrine, and tactics.

The addition of these tasks will make SOAMV certification more robust than that of a typical Sport Pilot, but still well within the capabilities of specially selected ground special operators. The SOAMV Syllabus proposed in Appendix A requires approximately 60 hours of flight time over the course of a six week training program. This intense period of flight instruction, along with 150—200 hours of simulator time, will produce proficient, certificated SOAMV Operators by the conclusion of the course.

By comparison, U.S. Air Force pilot trainees fly about 90 hours in 22 weeks to complete primary flight training as the first phase in Undergraduate Pilot Training. Air Force primary flight students fly powerful turboprop engine aircraft with complex electronic and hydraulic systems, retractable gear, and ejection seats. Civilian pilots

⁴⁰ Code of Federal Regulations, Title 14: Aeronautics and Space. PART 61—Certification: Pilots, Flight Instructors, and Ground Instructors §61.315. Faa.gov.

would never consider flying airplanes like these without hundreds of hours of prior experience. Because of the complexity of the aircraft, Air Force students spend significant amounts of time in ground school mastering the systems before flying the aircraft.

To train SOAMV operators, each SOAMV equipped unit should employ at least one instructor pilot to oversee the program, provide check-rides, and ensure that operations are conducted safely. Each unit should maintain at least one, networked, full motion simulator. These simulators will permit centralized tracking of SOAMV operator currency and will allow the schoolhouse to develop and promulgate specific simulator scenarios to address specific training requirements, such as mission profiles, commander's emphasis items, or safety-related training.⁴¹

In order to maintain currency in the SOAMV, operators will be required to log flight time according to Table 2. If an operator does not meet the currency requirements, he or she will be required to take a re-currency check ride with an instructor pilot, which covers all non-current tasks. All currency requirements should be logged during live flight operations. As indicated in Table 2, some tasks may alternatively be logged in the simulator.

⁴¹ In civilian flight training, vendors produce simulator scenarios that replicate actual aircraft accidents, and flight schools use these simulated, real-world emergencies to teach safety and aeronautical decision making.

Table 2. SOAMV Currency Requirements

Task	Currency Requirement	Number	Simulator
Landings	90 Days	3	No
Night Landings	180 Days	3	No
Formation Flight	180 Days	2 Hours	Yes
Night Formation	180 Days	2 Hours	Yes
NVG Landings	90 Days	3	No
Swarm Procedures	180 Days	2 Hours	Yes
Landing Zone Operations	180 Days	5 Landings	No
Formation Flight	180 Days	3 Hours	Yes

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II. CIVILIAN FLIGHT TRAINING

Since SOAMV pilots will share many basic training requirements with civilian Sport Pilots, a thorough review of established training programs will provide a starting point for the SOAMV training syllabus. Most civilian flight training is heavily focused on meeting the Practical Test Standards for the FAA checkride. SOAMV pilots will be required to fly at night, so their primary flight training program will require additional content beyond a sport pilot course. For that reason, examples of both sport pilot and private pilot syllabi are examined in Section I.A.

A. CIVILIAN FLIGHT TRAINING PROGRAMS

1. King Schools Private Pilot Syllabus

The King Schools is the leading producer of aviation training programs; according to its website, nearly half of the pilots trained around the world use King Schools' training to prepare for the FAA written and practical tests. The King Schools' Private Pilot flight syllabus arranges training into three stages with ten distinct phases, as outlined below:

Stage 1: Pre-Solo

Phase 1: Learning Your Airplane

Phase 2: Improving Control

Phase 3: Takeoffs and Landings

Phase 4: Preparing for Solo Flight

Phase 5: Solo Flight

Stage 2: Solo & Cross-Country

Phase 6: Getting Ready for Cross-Country Flying

Phase 7: Flying Cross-Country

Phase 8: Flying at Night

Phase 9: Advancing Your Skills

Stage 3: Preparing for Your Practical Test

Phase 10: Final Preparation for Your Practical Test⁴²

In the King syllabus, each phase has specific, measurable objectives and serves as a useful baseline for a SOAMV training syllabus. The organization into stages allows students to focus their attention and effort on meeting major milestones along the way and encourages the instructors to emphasize key skills at specific times.

As with all commercial syllabi, King emphasizes the Practical Test. In the SOAMV curriculum, training in tactics and employment would follow the practical test and culminate in a full mission profile as the capstone event.

2. Gleim Private Pilot Syllabus

Irvin N. Gleim, Ph.D., CIA, CMA, CFM, CPA, CFII, is a Professor Emeritus of the Fisher School of Accounting, University of Florida. He began publishing Gleim Knowledge Transfer Systems for accounting and aviation over 45 years ago, according to the Gleim.com website. Gleim Knowledge Transfer Systems are second in North American market share to King Schools.

The Gleim Curriculum, like the King School Syllabus is heavily focused on the FAA Practical Test Standards. The basic outline follows below.

Stage 1

Lesson 1: Introduction to Flight

Lesson 2: Four Fundamentals of Flight

Lesson 3: Basic Instrument Maneuvers

Lesson 4: Slow Flight and Stalls

Lesson 5: Emergency Operations

Lesson 6: Steep Turns and Ground Reference Maneuvers

⁴² "Private Pilot Syllabus," King Schools, accessed November 10, 2013, <http://www.kingschools.com>.

Lesson 7: Review

Lesson 8: Go Around and Forward Slip to Landing

Lesson 9: Pre-Solo Review

Lesson 10: Pre-Solo Review

Lesson 11: First Solo

Stage 1 Check–Lesson 12

Stage 2

Lesson 13: Second Solo

Lesson 14: Short Field and Soft Field Takeoffs and Landings

Lesson 15: Solo Maneuvers Review

Lesson 16: Navigation Systems

Lesson 17: Dual Cross Country

Lesson 20: Solo Cross Country

Lesson 21: Maneuvers Review

Lesson 22: Solo Practice

Lesson 23: Maneuvers Review

Lesson 24: Solo Practice

Stage 2 Check: Lesson 25⁴³

The Gleim Private Pilot Syllabus does not include recommended times, but assumes average sortie lengths of around 1.5 hours for most lessons, with extended sortie lengths (approximately 3.0) for cross-country flights. With those sortie lengths, a student would arrive at the minimum 40-flight hour requirement to take the FAA Practical Test at

⁴³ “Private Pilot Training Program,” Gleim Knowledge Transfer Systems, accessed May 5, 2013, <http://www.gleim.com>.

the end of the syllabus, assuming successful completion of all training objectives during each sortie. Remedial training or repeated lessons would increase the total time.

The Gleim Knowledge Transfer System relies on structured execution of a pre-brief, execute, de-brief methodology. Each training objective of the day is discussed in detail on the ground first, executed in the air, and then discussed after the flight. This structure provides consistent expectations for student learning and allows the student to anticipate the flight maneuvers and to study in advance. One downside is that, this system limits the ability of the instructor to advance students who are performing above average, or who master certain maneuvers quickly. Instructors are discouraged from introducing new maneuvers during the sortie if they have not been pre-briefed on the ground.⁴⁴

3. Sport Pilot Syllabus: 5500 Feet Flight Training

Joel Severinghaus is a professional Certified Flight Instructor in Iowa who publishes the following Sport Pilot training syllabus for use in his line of flight training centers. Of note, Mr. Severinghaus includes the hours of flight time recommended to complete each portion of the training. In the outline that follows, “dual” stands for dual instruction, meaning that a certified flight instructor is on board the aircraft; “solo” means that the student pilot is alone in the aircraft.

This syllabus is designed to prepare pilots for the FAA’s Sport Pilot Practical Test.

Flight 1: Introductory flight	0.5 hours dual
Flight 2: Ground operations & basic maneuvers	1.0 dual
Flight 3: Ground operations & basic maneuvers	1.0 dual
Flight 4: Ground reference maneuvers	1.0 dual
Flight 5: Emergency procedures	1.0 dual
Flight 6: Airport operations	1.0 dual

⁴⁴ “Private Pilot Training Program,” Gleim Knowledge Transfer Systems, accessed May 5, 2013, <http://www.gleim.com>.

Flight 7: Normal takeoffs & landings 1.0 dual

Flight 8: Review for solo 1.0 dual

Flight 9: First solo 0.5 dual

0.5 solo

Flight 10: Performance takeoffs & landings 1.0 dual

Flight 11: Solo takeoffs & landings 1.0 solo

Flight 12: Navigation 1.0 dual

Flight 13: Solo maneuvers 1.0 solo

Flight 14: Dual cross-country 2.0 dual

Flight 15: Short solo cross-country 1.0 solo

Flight 16: Long solo cross-country 1.5 solo

Flight 17: Review & prep for practical exam 1.5 dual

Flight 18: Review & prep for practical exam 1.5 dual

Minimum flight training required 20 hours

15 dual

5 Solo⁴⁵

5500 Feet Flight Training aims to train its students to test at the FAA's minimum hourly time of 20 hours. Since this is a Sport Pilot syllabus, night flying is not included. This syllabus is a bare-bones example of the minimal training required to produce a Sport Pilot. In order to follow this syllabus and test at minimal time, the student would need to perform to standard on each flight.

⁴⁵ "Sport Pilot," 5500 Feet Flight Training, accessed July 27, 2013. <http://www.5500feet.com>.

4. Society of Aviation and Flight Educators Sport Pilot Syllabus

The SAFE Syllabus is much less aggressive than the preceding 5500 Feet syllabus when it comes to recommended hourly training times. The SAFE syllabus recognizes the variability in student proficiency rates by including a range of possible training times from 25 to 33 hours. This range of times is consistent with national averages and standard deviation data collected by the Aircraft Owners and Pilots Association.

SPORT PILOT TRAINING SYLLABUS

LESSON ONE: INTRODUCTORY FLIGHT

TIME: 1 hour Ground Instruction; 1 hour Flight Instruction

LESSON TWO: BASIC FLIGHT MANEUVERS

TIME: 45 minutes Ground Instruction; 1—2 hours Flight Instruction

LESSON THREE: HIGH FLIGHT MANEUVERS

TIME: 1–2 hours Ground Instruction; 1–2 hours Flight Instruction

LESSON FOUR: LOW FLIGHT MANEUVERS

TIME: 1–2 hours Ground Instruction; 1–2 hours Flight Instruction

LESSON FIVE: TAKEOFFS AND LANDINGS

TIME: 1–2 hours Ground Instruction; 2–3 hours Flight Instruction

LESSON SIX: EMERGENCY PROCEDURES IN THE PATTERN

TIME: .5–1 hour Ground Instruction; 2–3 hours Flight Instruction

STAGE CHECK: ONE

LESSON SEVEN: SUPERVISED SOLO TAKEOFFS & LANDINGS

TIME: 1–2 hours Ground Instruction; 1 hour Flight Instruction; 2–3 hours Solo

LESSON EIGHT: SOLO TAKEOFFS AND LANDINGS

TIME: .5–1 hour Flight Instruction; 1–4 hours Solo Flight

LESSON NINE: INTRODUCTION TO CROSS COUNTRY FLIGHT

TIME: 2–4 hours Ground Instruction; 2 hours Flight Instruction

LESSON TEN: CROSS COUNTRY FLIGHT

TIME: 1 hour Ground Instruction; 2–4 hours Flight Instruction

STAGE CHECK: TWO

LESSON ELEVEN: SOLO CROSS COUNTRY FLIGHT

TIME: 2—3 Hours Solo Flight

LESSON TWELVE: PREPARATION FOR THE PRACTICAL TEST

TIME: 2—5 hours Ground Instruction; 3—5 hours Flight Instruction

TOTAL TRAINING TIMES:

Ground Instruction: 10—18 hours

Flight Instruction: 15—25 hours

Solo Flight: 5—10 hours⁴⁶

The SAFE syllabus highlights the use of stage checks. The checks consist of verbal quizzes to verify understanding followed by flight-testing to confirm execution of the specific skills required in all of the preceding lessons. This method is similar to the ubiquitous Department of Defense “Task, Condition, Standard” format. SAFE includes clearly defined objectives and very specific completion standards for each lesson and each check. These standards are designed to prepare the student to meet or exceed the FAA’s Practical Test Standards and follow the same grading convention.

5. Redbird Skyport Private Pilot Program

The Redbird Skyport is a full time flight school and a flight training learning laboratory for Redbird Flight Simulation. The Skyport claims to be “the most advanced flight school in the country,” and backs that claim with its unique training model, business model, pricing model, and groundbreaking use of simulators in primary flight training.⁴⁷

Redbird’s training model is called the Migration Flight Training Method. The primary premise of the Migration Method is proficiency-based training; students train to a specific level of proficiency instead of focusing on the number of flight hours. The FAA accredits Skyport as a Part 141 school (Which means it is governed by Part 141 of

⁴⁶ “Sport Pilot Syllabus,” Society of Aviation and Flight Educators, accessed May 10, 2013.

⁴⁷ Ian J. Twombly, “Big Idea,” *Flight Training Magazine*, January 2013, <http://flighttraining.aopa.org/magazine/2013/January/feature-skyport.html>.

the Federal Aviation Regulations). This accreditation allows Skyport to recommend students for the Practical Test at the completion of training; no minimum flight time is required.

At Skyport, students progress through the curriculum at the pace of demonstrated proficiency, without being tied to hourly minimums or a specified sortie plan.

Since its parent company's core business is flight simulation, Redbird Skyport was created to study the integration of advanced full-motion simulation into the primary flight school environment. All skills are learned in the simulator first before students attempt them in the air. The simulators are equipped to run preset scenarios that teach new concepts and grade student performance; students are permitted unlimited access to the simulators during their course of study. This policy allows students who may be falling behind to conduct self-study remedial training, even without a Flight Instructor present.

Data collected from Skyport students indicates that simulator training dramatically reduces the flight time required and produces very competent pilots in less time than traditional "aircraft-only" training programs. Student pilots in the United States average 75 hours of flight time before passing the Private Pilot Practical Test. Skyport students average 38 hours in the air. According to the FAA, only 29.5% of student pilots completed flight training and passed the Practical Test from 2010–2012. Skyport has a 97% pass rate.

Although Skyport's training methodology is revolutionary, its syllabus is relatively pedestrian. The syllabus, outlined below, shares a staged structure with other training models, although it intentionally omits flight time targets or specific sortie requirements. The syllabus is designed to act as a general guide with specific performance parameters that prepare a student for the FAA Practical Test Standards. This curriculum eschews check-rides in favor of daily performance goals that slowly increase throughout the learning process.

STAGE 1: Fundamentals of Flight

OBJECTIVE: Learn the basic concepts of airplane control and flight.

TASKS: Takeoff, Climbs and Descents, Normal Turns, Airspeed Changes

COMPLETION STANDARD: With minimal instructor assistance hold assigned altitude (+/- 200 feet), airspeed (+/- 15 knots), and heading (+/- 20 degrees).

STAGE 2: Basic Maneuvers and Procedures

OBJECTIVE: Build skill and confidence to prepare for your first solo flight.

TASKS: Slow Flight, Stalls, Simulated Emergencies, Ground Reference Maneuvers Landings, Communications, Decision Making, Task Management

COMPLETION STANDARD: Make safe in-flight decisions and effective radio communications while holding assigned altitude (+/- 200 feet), airspeed (+/- 15 knots), and heading (+/- 20 degrees).

STAGE 3: Solo Flight

OBJECTIVE: Build solo flight experience and improve your skills.

TASKS: Solo Flight, Steep Turns, Short and Soft Field Takeoffs and Landings

COMPLETION STANDARD: Make safe solo flights and perform maneuvers while holding assigned altitude (+/- 150 feet), airspeed (+/- 10 knots), and heading (+/- 10 degrees).

STAGE 4: Cross-Country Flight and Experience Building

OBJECTIVE: Learn and practice cross country flight skills with and without your instructor.

TASKS: Flight Planning, In-Flight Diversion, Instrument Flight, Solo Flight

COMPLETION STANDARD: Make safe solo flights and perform maneuvers while holding assigned altitude (+/- 100 feet), airspeed (+/- 10 knots), and heading (+/- 10 degrees).

STAGE 5: Practical Test Preparation

OBJECTIVE: Polish the skills acquired in previous stages to checkride standards.

TASKS: All

COMPLETION STANDARD: FAA Private Pilot Practical Test Standards.⁴⁸

The Skyport Migration Training Model presents revolutionary concepts in both primary flight and simulation training. Although the military uses simulators heavily in both primary and advanced pilot training, its simulators are manpower intensive and require technicians to operate the simulators and instructor pilots to introduce concepts and grade students. Redbird simulators require only the involvement of the student. The simulators contained pre-loaded training scenarios that are assigned to students as the course progresses. The machine presents the necessary concepts and information to the student, then grades student performance and provides real-time feedback.

Once a student demonstrates proficiency in the simulator, the flight instructor's job is to help him or her transition those skills into the aircraft. Instead of teaching new skills in the sky, the instructors help with the transition from simulated to live flight.

Because of Skyport's excellent safety record, high levels of proficiency, substantial cost-reductions, and time-savings, the SOAMV Syllabus will borrow much of the Migration Training Model's methodology and training philosophy. SOAMV Training should also rely heavily on modern simulators that instruct candidates and provide feedback.

⁴⁸ "Private Pilot," Redbird Skyport, accessed November 9, 2013, <http://www.redbirdskyport.com>.

III. SOAMV TRAINING

A. KNOWLEDGE TRAINING

SOAMV candidates will receive a commercial off-the-shelf private pilot course 60 days in advance of their course start date and will complete the course of instruction at their duty station. The SOAMV Program Manager will select the specific course of instruction in accordance with applicable contracting regulations and best practices. The course selected should cover all facets of the Federal Aviation Knowledge Test as described in Title 14 of the Code of Federal Regulations (14 CFR) part 61, section 61.35, Knowledge Test. The course should include all necessary training aids (flight computer and aviation plotter) required to pass the knowledge test. The course must include online testing and produce a Certificate of Completion upon satisfactory execution of all training modules. Some examples of courses that meet these requirements follow.

King School's Private Pilot Course: \$279⁴⁹

Gleim Online Ground School: \$249⁵⁰

Jeppesen Private Pilot Kit: \$224⁵¹

Most online courses will require approximately 20–30 hours of study, testing, question review, and practical exercises. Instructors will inspect each candidate's Certificate of Completion for the online course upon arrival at the training location.

B. KNOWLEDGE TESTING

SOAMV candidates will complete an electronic knowledge test upon arrival at the training location. To minimize start-up costs, the SOAMV School could use the standardized FAA's Airmen's Knowledge Test for private pilots. This test will cover 90% of the knowledge required for SOAMV operations. The candidates will be required

49 "Private Pilot Course," King Schools, accessed November 1, 2013, <http://www.kingschools.com>.

50 "Online Ground School," Gleim Knowledge Transfer Systems, accessed November 1, 2013, <http://www.gleim.com>.

51 "Private Pilot Kit," Jeppesen, accessed November 1, 2013, <http://www.jeppesen.com>.

to demonstrate mastery of the remaining portion (military tactics, techniques, and procedures) during the practical testing phase of SOAMV training. The knowledge test serves as an initial screening mechanism to identify motivation and aptitude for pilot training while teaching the vocabulary and concepts required for success during flying portion of the syllabus.

C. DEMONSTRATED PROFICIENCY TRAINING MODEL: EXPLAIN, SIMULATE, FLY

1. Simulator Training

Commercial off-the-shelf training simulators play an important role in reducing risk by acclimating SOAMV candidates to pilot workload in a controlled environment. Simulators are a proven part of military and professional flight training programs, but are conspicuously absent in most primary flight schools due to their high initial costs.

As demonstrated at the Redbird Skyport, properly equipped simulators can play an essential role in a well-designed training curriculum. Simulator training will be a pivotal part of flight training through all phases of the SOAMV program. All sorties and maneuvers will be introduced, taught, graded, and successfully completed in the simulator before a student steps into an aircraft for a live flight.

A simulator-first program has a number of financial and safety advantages over an all live flight program. Simulators significantly reduce wear and tear on the aircraft since candidates work out many of their big mistakes (such as jarring landing errors) in the simulator before moving to the aircraft. Introducing new maneuvers using a standardized software program eliminates whatever disparities may exist between instructors and gives each candidate the same information and the same quality of instruction. Real time feedback during instruction also eliminates frustrating subjective assessments and allows the student to focus on the skills, not on pleasing an instructor.

In addition, simulators mitigate risk by ensuring a minimum level of competency before a candidate takes control of a live aircraft. Instructors will assist candidates with transitioning their skills to the live aircraft instead of serving as primary flight instructors.

This allows for a more focused flight experience and permits more instruction time devoted to perfecting maneuvers rather than building entirely new neural pathways in flight.

At the same time, graded simulations will encourage students to execute maneuvers with precision in the simulators. This precision should form positive habits in the simulators that the students transfer to the aircraft. For example, emergency procedures and dangerous flight conditions that are impractical to execute in a live aircraft can be safely replicated in the simulator to help candidates internalize the consequences of aeronautical decision making—especially outside of the approved performance envelope.

Student-operated simulators encourage students to make the most of their study time to prepare for their next live flight, even if they need additional practice after hours. Since each flight is tracked and graded, students should not end up misusing the simulators or developing negative transference. This feature allows students who struggle with any particular aspect of the syllabus to put in extra practice to master difficult skills, and also notifies the flight instructors where a student is strong, or needs more help.

As previously noted, student-operated simulators will dramatically reduce the instructor manpower required. For primary instruction in live flight, a one-to-one instructor to student ratio is required; each candidate requires an instructor to fly with him or her in the airplane. At ratios of less than one-to-one, candidate downtime and instructor workload both increase precipitously. In a simulated environment, instructors are additive, but not required. One instructor could easily oversee six to eight candidates and offer additional techniques or hints where needed. The school should arrange daily schedules to stagger simulation and live flight instruction to make efficient use of the simulators, instructors, and aircraft.

The simulators employed in the SOAMV program should meet the following criteria:

- 1). Introduce new concepts through pre-programmed lessons
- 2). Demonstrate new concepts through pre-programmed flight sequences

- 3). Provide real-time feedback to students
- 4). Self-grade and deliver candidate performance data to instructors
- 5). Employ software and hardware that can be student-operated
- 6). Network together for combined flight operations
- 7). Accept new training modules over the network
- 8). Include training on operating effectively with night vision goggles

After primary flight training, advanced simulators will remain critical for proficiency training at geographically separated units. Instructors at a SOAMV Schoolhouse will be able to create specific training scenarios and push them to networked simulators around the globe. As certified SOAMV operators run through the scenarios at their units, scoring and results can be reported at various levels to enable oversight and allow for comparative ratings between pilots and across units. If desired, these simulators can even be connected across classified networks for mission rehearsal.

2. Flight Training

Based on the Redbird Skyport Demonstrated Proficiency Model, SOAMV operators should be required to explain maneuvers and concepts on the ground, demonstrate them in the simulator, and then proceed to live flight training.

During flight training, flight instructors will accompany the students each day from simulator rehearsals, to flight planning, through the day's flight, and to the end of the post-flight debrief. As the course progresses, the instructors will transition from training, to assisting, to observing/grading.

D. FLIGHT TESTING

SOAMV candidates will perform practical flight tests as illustrated in Appendix A to ensure that they are progressing at a reasonable rate and have mastered the skills necessary to progress to more advanced maneuvers. At the beginning of the course, these tests or "check-rides" will be largely objective. Candidates will execute pre-planned maneuvers with specific performance criteria to confirm that they have mastered the

motor skills required to safely operate the SOAMV. As the course progresses, the tests should become more subjective in nature and need to be designed to test judgment, decision-making, and reactions to stress.

E. FINAL CERTIFICATION TESTING

The final event for SOAMV candidates will be a graded event that covers mission planning, flight planning, mission brief, simulator rehearsal, aircraft preparation and field maintenance, a final check-ride with an instructor, aircraft post-flight, and mission debrief. The SOAMV Operator Validation Exercise (SOVE) is designed to mimic a realistic mission from start to finish and evaluate each candidate's ability to evaluate and plan the mission, make prudent aeronautical and tactical decisions, and execute the mission to standard. The SOAMV Syllabus in Appendix A contains extensive detail on SOVE methodology and standards. Candidates who successfully pass the SOVE will have demonstrated their ability to execute SOAMV missions.

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IV. CONCLUSION

The Special Operations Air Mobility Vehicle may prove to be an incredible force multiplier for SOF. These simple air vehicles could be the technology that enables swarm warfare and effectively distributes mission risk across the force. Already, Air Mobility Vehicles would be immediately beneficial in more traditional mission sets like reconnaissance, search and rescue, and landing zone surveys.

SOAMVs complement the existing Special Operations aviation force structure, but are not designed to compete with the range, payload, or robustness of military-grade aviation hardware. At the same time, these specialized designs remain incredibly inexpensive and simple to operate—they are expressly designed for part-time pilots. Because of its affordability and simplicity, SOAMV aircraft are excellent tools by which to help build capacity in partner nation SOF forces.

In order to train Special Operators to safely and effectively employ SOAMVs, USSOCOM should establish a joint training center to teach primary flight training according to the syllabus in Appendix A. This syllabus relies heavily on networked, student-operated, full-motion simulators to present flight concepts and grade student performance. This simulator-based model has proven itself through remarkable increases in safety and proficiency in civilian flight research, and should be considered the foundation for successful SOAMV primary training, currency training, and mission rehearsals.

To advance the SOAMV concept, USSOCOM should select one or more Light-sport aircraft as SOAMV platform(s) and sponsor research on mission-specific modifications, employment doctrine, and integrated tactics.

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APPENDIX A. SOAMV OPERATOR'S COURSE SYLLABUS

1 December 2013

Table of Contents

A.	STAGE 1: FLIGHT FUNDAMENTALS	44
1.	Training Day 1: Introduction to Flight.....	44
2.	Training Day 2: Takeoffs & Landings.....	44
3.	Training Day 3: Airport Operations, Takeoffs & Landings.....	45
4.	Training Day 4: Traffic Patterns, Takeoffs & Landings.....	46
5.	Training Day 5: STAGE ONE CHECK RIDE (Pre-Solo Check)	47
B.	STAGE 2: BASIC MANEUVERS AND PROCEDURES	49
1.	Training Day 6: First Solo Flight	50
2.	Training Day 7: Ground Reference Maneuvers	50
3.	Training Day 8: Soft and Short Field Operations	51
4.	Training Day 9: Landing Zone Operations	51
5.	Training Day 10: Landing Zone Solo Flight.....	52
C.	STAGE 3: CROSS COUNTRY FLIGHT.....	25
1.	Training Day 11: Cross Country Flight.....	53
2.	Training Day 12: Night Cross Country Flight	54
3.	Training Day 13: Night Landing Zone Operations	54
4.	Training Day 14: Solo Cross Country Flight	55
5.	Training Day 15: STAGE THREE CHECK RIDE	55
D.	STAGE 4: TACTICAL SKILLS.....	58
1.	Training Day 16: Night Vision Goggle Familiarization	59
2.	Training Day 17: Night Vision Goggle Takeoffs and Landings	59
3.	Training Day 18: Night Vision Goggle Cross Country.....	59
4.	Training Day 19: Night Vision Goggles & Unattended Landing Zones	60
5.	Training Day 20: Night Vision Goggle Solo Flight	61
E.	STAGE 5: SOAMV EMPLOYMENT	61
1.	Training Day 21: Formation Flight (2 Ship)	62
2.	Training Day 22: Formation Departures and Arrivals (4-Ship)	62
3.	Training Day 23: Formation Flight & Opportune LZ	63
4.	Training Day 24: Formation Flights & Landing Zones (4 Ship).....	63
5.	Training Day 25: Night Formation Flight (4 Ship).....	64
F.	STAGE 6: SOAMV DEPLOYMENT	65
1.	Training Day 26A: Aircraft Assembly, Disassembly, and Cache.....	65
2.	Training Day 26B: Flight Envelope Awareness	66
3.	Training Day 27: Full Mission Profile 1–Insert the Force	66
4.	Training Day 28: Full Mission Profile 2–Extract the Force	67
5.	Training Day 29: Full Mission Profile 3–Combat Search & Rescue	67
6.	Training Day 30: SOAMV Operator Validation Exercise.....	68

A. STAGE 1: FLIGHT FUNDAMENTALS

DESCRIPTION: During this stage, SOAMV candidates will become familiar with the flight characteristics of the aircraft and understand the basic aerodynamic forces at work.

OBJECTIVE: Learn the basic concepts of airplane control and flight.

TASKS: Takeoff, Climbs and Descents, Normal Turns, Airspeed Changes

COMPLETION STANDARD: With minimal instructor assistance hold assigned altitude (+/- 200 feet), airspeed (+/- 15 knots), and heading (+/- 20 degrees).

1. Training Day 1: Introduction to Flight

a. Simulator Scenario 1: Begin at the end of the runway, take off, follow prompts to execute the following learning objectives:

- (1) Takeoffs
- (2) Straight and Level Flight
- (3) Coordinated Cruising Turns
- (4) Dutch Rolls for Coordination
- (5) Climbs and Descents With Turns
- (6) Climbing and Descending Turns With Flaps
- (7) Airspeed Control on Landings

b. Flight Lesson 1 (1.0 Hours) Introduction Flight. With Instructor assistance, take off and fly to the practice area and return.

- (1) Takeoffs
- (2) Straight and Level Flight
- (3) Coordinated Cruising Turns
- (4) Dutch Rolls for Coordination
- (5) Climbs and Descents With Turns
- (6) Climbing and Descending Turns With Flaps
- (7) Airspeed Control on Landings
- (8) Airspace Awareness
- (9) Area Landmarks and Aerial recognition

2. Training Day 2: Takeoffs & Landings

a. Simulator Scenario 2: Begin at parking, start aircraft, taxi to runway, take off, fly in the pattern, and land. Follow prompts to execute the following learning objectives:

- (1) Checklist use

- (2) Taxiing
- (3) Run-up's
- (4) Air Traffic Control Communications
- (5) Takeoffs
- (6) Normal Landings
- (7) Runway Alignment
- (8) Go Arounds

b. Flight Lesson 2 (1.0 Hours) Takeoff and Landing. With Instructor assistance, start the aircraft, taxi to the runway, take off and fly in the pattern, and land.

- (1) Preflight Walk Around Preparation
- (2) Checklist use
- (3) Taxiing
- (4) Run-up's
- (5) Air Traffic Control Communications
- (6) Takeoffs
- (7) Normal Landings
- (8) Runway Alignment
- (9) Go Arounds

3. Training Day 3: Airport Operations, Takeoffs & Landings

a. Simulator Scenario 3: Begin at parking, start aircraft, taxi to runway, take off, fly to the training area, return to the airport, enter the pattern, and land. Follow prompts to execute the following learning objectives:

- (1) Slips to a Landing
- (2) Cross-Wind Takeoffs
- (3) Cross-Wind Landings
- (4) Equipment Malfunction Including Radio Failure
- (5) SOAMV Powerplant
- (6) Airport Operations

b. Flight Lesson 3 (1.5 hours) Takeoff and Landing. With minimal instructor assistance, start the aircraft, taxi to the runway, take off, fly to the training area, return to the airport, enter the pattern and land.

- (1) Slips to a Landing and Slips to lose altitude
- (2) Cross-Wind Takeoffs

- (3) Cross-Wind Landings
- (4) Equipment Malfunction Including Radio Failure
- (5) SOAMV Powerplant and Systems
- (6) Airport Operations

4. Training Day 4: Traffic Patterns, Takeoffs & Landings

a. *Simulator Scenario 4: Begin at parking, start aircraft, taxi to runway, take off, fly to the training area, conduct specified maneuvers, return to the airport, enter the pattern, and land. Follow prompts to execute the following learning objectives:*

- (1) Slow Flight With and Without Flaps
- (2) Steep Turns
- (3) Power-Off Stalls (Approach Stalls)
- (4) Stall Recovery
- (5) Power-On Stalls (Departure Stalls)

b. *Flight Lesson 4: Takeoff and Landing. With minimal instructor assistance, start the aircraft, taxi to the runway, take off, fly to the training area, conduct specified maneuvers, return to the airport, enter the pattern, and land.*

- (1) Slow Flight With and Without Flaps
- (2) Steep Turns
- (3) Power-Off Stalls (Approach Stalls)
- (4) Stall Recovery
- (5) Power-On Stalls (Departure Stalls)

5. Training Day 5: STAGE ONE CHECK RIDE (Pre-Solo Check)

a. *Simulator Scenario 5: CHECK RIDE PREP. Begin at parking, start aircraft, taxi to runway, take off, fly to the training area, conduct specified maneuvers, react to simulated emergencies, return to the airport, execute multiple patterns and landings until complete. Follow prompts to execute the following learning objectives:*

- (1) Checklist use
- (2) Taxiing
- (3) Run-up
- (4) Air Traffic Control Communications
- (5) Takeoffs
- (6) Normal Landings
- (7) Emergency Procedures (Engine, Radio, Electrical failures)

(8) Go Arounds

- b. ***Flight Lesson 5: PRE-SOLO CHECK RIDE. With no instructor assistance, start the aircraft, taxi to the runway, take off, fly to the training area, react appropriately to simulated emergencies conduct specified maneuvers, return to the airport, enter the pattern, and land.***

Test Conditions: Day, Visual Meteorological Conditions (VMC), Wind < 15 knots, Crosswind Component < 10 knots, turbulence moderate or below.

Flight Standards: Make safe in-flight decisions and effective radio communications while holding assigned altitude (+/- 200 feet), airspeed (+/- 15 knots), and heading (+/- 20 degrees).

(1) TASK: Checklist use
STANDARDS

Q1: Candidate employs published checklists during appropriate phases of flight.

Q2: Candidate misses three or fewer checklist items during the check ride

Q3: Candidate misses four or more checklist items during the check ride, or fails to bring or utilize checklist appropriately during the flight.

(2) Taxiing
STANDARDS

Q1: Candidate maintains the centerline (+/- five feet), clears before turning, and complies with applicable airport procedures and tower instructions.

Q2: Candidate maintains the centerline (+/- ten feet), clears before turning, and complies with applicable airport procedures and tower instructions.

Q3: Candidate deviates more than ten feet from the centerline, fails to clear before turning, or fails to comply with applicable airport procedures or tower instructions.

(3) Run-up
STANDARDS

Q1: Candidate conducts run-up in accordance with SOAMV checklist.

Q2: Candidate conducts run-up in accordance with SOAMV checklist with two or fewer errors.

Q3: Candidate conducts run-up in accordance with SOAMV checklist with three or more errors

(4) Air Traffic Control Communications
STANDARDS

Q1: Candidate communicates confidently in accordance with International Civil Air Organization (ICAO) standards.

Q2: Candidate communicates with difficulty or hesitation in accordance with ICAO Standards with four or fewer errors.

Q3: Candidate fails to communicate in accordance with ICAO Standards with five or more errors

(5) Takeoffs
STANDARDS

Q1: Candidate maintains the centerline (+/- five feet), rotates at the proper speed, and complies with applicable airport procedures and tower instructions.

Q2: Candidate maintains the centerline (+/- ten feet), clears before turning, and complies with applicable airport procedures and tower instructions.

Q3: Candidate deviates more than ten feet from the centerline, fails to clear before turning, or fails to comply with applicable airport procedures or tower instructions.

(6) Normal Landings
STANDARDS

Q1: Candidate maintains the centerline (+/- five feet), maintains appropriate speed throughout the pattern (+/- ten knots), lands in the touchdown area (+/- 500 feet) without excessive impact or pilot induced oscillations, and complies with applicable airport procedures and tower instructions.

Q2: Candidate maintains the centerline (+/- ten feet), maintains appropriate speed throughout the pattern (+/- 15 knots, but never at or below stall speed), lands in the touchdown area (+/- 1,000 feet) with significant impact or minor pilot-induced oscillations, and complies with applicable airport procedures and tower instructions.

Q3: Candidate fails to maintain the centerline (> ten feet), maintains appropriate speed throughout the pattern (>15 knots, or at or below stall speed), fails to land in the touchdown area (>1,000 feet), lands with excessive impact or significant pilot-induced oscillations, or fails to comply with applicable airport procedures and tower instructions.

(7) Emergency Procedures (Engine, Radio, Electrical failures)
STANDARDS

Q1: Candidate conducts EPs (Emergency Procedures) in accordance with the SOAMV Checklist.

Q2: Candidate conducts EPs in accordance with the SOAMV Checklist with three or fewer errors.

Q3: Candidate conducts EPs in accordance with the SOAMV Checklist with four or more errors

(8) Go-arounds
STANDARDS

Q1: Candidate conducts go-around procedures in accordance with the SOAMV Checklist, maintains the centerline (+/- five feet), rotates at the proper speed (if applicable), and complies with airport procedures and tower instructions.

Q2: Candidate conducts go-around procedures in accordance with the SOAMV Checklist with fewer than three errors, maintains the centerline (+/- 10 feet), rotates at the proper speed (if applicable), and complies with airport procedures and tower instructions.

Q3: Candidate deviates more than ten feet from the centerline, fails to follow SOAMV Checklist, or fails to comply with applicable airport procedures or tower instructions.

B. STAGE 2: BASIC MANEUVERS AND PROCEDURES

OBJECTIVE: Conduct first solo flight and build flight experience

TASKS: Solo flight, Ground Reference Maneuvers, Steep Turns, Short and Soft Field Takeoffs and Landings

COMPLETION STANDARD: Conduct safe solo flights and perform maneuvers while holding assigned altitude (+/- 150 feet), airspeed (+/- 10 knots), and heading (+/- 10 degrees).

1. Training Day 6: First Solo Flight

a. *Simulator Scenario 6: Begin at parking, start aircraft, taxi to runway, take off, fly to the training area, conduct specified maneuvers, return to the airport, enter the pattern, execute multiple patterns and landings until complete. Follow prompts to execute the following learning objectives:*

- (1) Checklist use
- (2) Takeoffs
- (3) Normal Landings
- (4) Emergency Procedures (Engine, Radio, Electrical failures)
- (5) Go-arounds
- (6) Slow Flight With and Without Flaps
- (7) Steep Turns
- (8) Power-Off Stalls (Approach Stalls)
- (9) Stall Recovery
- (10) Power-On Stalls (Departure Stalls)

b. *Flight Lesson 6: FIRST SOLO. With no instructor assistance, start the aircraft, taxi to the runway, take off, remain in the pattern, and conduct multiple patterns until cleared to Solo. Conduct Solo pattern flight.*

- (1) Checklist use
- (2) Takeoffs
- (3) Normal Landings
- (4) Emergency Procedures (Engine, Radio, Electrical failures)
- (5) Go-arounds
- (6) Solo Flight

2. Training Day 7: Ground Reference Maneuvers

a. *Simulator Scenario 7: Begin at parking, start aircraft, taxi to runway, take off, fly to the training area, conduct specified maneuvers, return to the airport, enter the pattern, execute multiple patterns and landings until complete. Follow prompts to execute the following learning objectives:*

- (1) Rectangular Patterns
- (2) Turns Around a Point
- (3) “S” Turns over a road or power line
- (4) Emergency Procedures

b. *Flight Lesson 7: Ground Reference Maneuvers. With no instructor assistance, start the aircraft, taxi to the runway take off, fly to the training area, conduct specified maneuvers, return*

to the airport, enter the pattern, execute multiple patterns and landings until complete. Conduct solo pattern flight.

- (1) Rectangular Patterns
- (2) Turns Around a Point
- (3) “S” Turns over a road or power line
- (4) Emergency Procedures
- (5) Solo Flight

3. Training Day 8: Soft and Short Field Operations

a. Simulator Scenario 8: Begin at parking, start aircraft, taxi to runway, take off, fly to the landing zone (LZ) training area, conduct specified maneuvers, return to the airport, enter the pattern, execute multiple patterns and landings until complete. Follow prompts to execute the following learning objectives:

- (1) Short Field Takeoffs
- (2) Short Field Landings
- (3) Soft Field Takeoffs
- (4) Soft Field Landings

b. Flight Lesson 8: Soft and Short Field Operations. With no instructor assistance, start the aircraft, taxi to the runway take off, fly to the LZ training area, conduct specified maneuvers, return to the airport, enter the pattern, execute multiple patterns and landings until complete. Conduct solo pattern flight.

- (1) Short Field Takeoffs
- (2) Short Field Landings
- (3) Soft Field Takeoffs
- (4) Soft Field Landings

4. Training Day 9: Landing Zone Operations

a. Simulator Scenario 9: Begin at parking, start aircraft, taxi to runway, take off, fly to the landing zone (LZ) training area, conduct specified maneuvers, return to the airport, enter the pattern, execute multiple patterns and landings until complete. Follow prompts to execute the following learning objectives:

- (1) LZ Control Officer Operations
- (2) Unattended LZ Operations
- (3) Prepared LZ Operations
- (4) Unprepared LZ Operations
- (5) Opportune LZ Operations

b. *Flight Lesson 9: Landing Zone Operations. With no instructor assistance, start the aircraft, taxi to the runway take off, fly to the LZ training area, conduct specified maneuvers, return to the airport, enter the pattern, execute multiple patterns and landings until complete. Conduct solo pattern flight.*

- (1) LZ Control Officer Operations
- (2) Unattended LZ Operations (Simulated)
- (3) Prepared LZ Operations
- (4) Unprepared LZ Operations
- (5) Opportune LZ Operations

5. Training Day 10: Landing Zone Solo Flight

a. *Simulator Scenario 10: Begin at parking, start aircraft, taxi to runway, take off, fly to the landing zone (LZ) training area, conduct specified maneuvers, return to the airport, enter the pattern, execute multiple patterns and landings until complete. Follow prompts to execute the following learning objectives:*

- (1) Normal Takeoffs
- (2) Normal Landings
- (3) Soft Field Landings
- (4) Soft Field Takeoffs
- (5) Prepared LZ Operations
- (6) Emergency Procedures (Engine, Radio, Electrical failures)
- (7) Go Arouns

b. *Flight Lesson 10: Landing Zone Solo Flight. With no instructor on board, start the aircraft, taxi to the runway take off, fly to the LZ training area, conduct specified maneuvers, return to the airport, enter the pattern, and land.*

- (1) Soft Field Landings
- (2) Soft Field Takeoffs
- (3) Prepared LZ Operations

C. STAGE 3: CROSS-COUNTRY FLIGHT

OBJECTIVE: Learn and practice cross-country flight skills with and without instructor.

TASKS: Flight Planning, Navigation, In-Flight Diversion, Instrument Flight, Solo Flight, Night Operations, Night LZ Operations.
COMPLETION STANDARD: STAGE FOUR CHECK RIDE.

1. Training Day 11: Cross Country Flight

a. *Simulator Scenario 11: Cross-country flight. Given a destination, with minimal instructor assistance, plan a cross-country trip with one leg, fly the mission in the simulator as briefed and return. Follow prompts to execute the following learning objectives*

- (1) VOR (VHF Omnidirectional Radio) Navigation
- (2) GPS (Global Positioning System) Navigation
- (3) Military Beacon Navigation
- (4) Aerial Map Reading and Dead Reckoning
- (5) Instrument Approach aids
- (6) ATC Assistance Available
- (7) Fuel Planning and Fuel Management
- (8) Military Satellite Communication and tracking
- (9) Basic Hooded Turns
- (10) Basic Hooded Climbs and Descents
- (11) Hooded 180° Weather Turns
- (12) Hooded Unusual Attitudes

b. *Flight Lesson 11: Cross-country Flight. Given a destination, with minimal instructor assistance, plan a cross-country trip with one leg, brief instructor, fly the mission as briefed, and return.*

- (1) VOR (VHF Omnidirectional Radio) Navigation
- (2) GPS (Global Positioning System) Navigation
- (3) Military Beacon Navigation
- (4) Aerial Map reading and dead reckoning
- (5) Instrument Approach aids
- (6) ATC Assistance Available
- (7) Fuel Planning and Fuel Management
- (8) Military Satellite Communication and tracking
- (9) Basic Hooded Turns
- (10) Basic Hooded Climbs and Descents
- (11) Hooded 180° Weather Turns
- (12) Hooded Unusual Attitudes

2. Training Day 12: Night Cross Country Flight

a. *Simulator Scenario 12: Given multiple destinations, plan and execute a night cross-country mission in the simulator. Follow prompts to execute the following learning objectives*

- (1) Night Full Stop Landings
- (2) Landing Light Out Operation
- (3) Night Optical Illusions
- (4) Cockpit Lighting
- (5) Aircraft Lighting and Electrical Systems

b. *Flight Lesson 12: Night Cross-country Flight. Given a destination, with minimal instructor assistance, plan a cross-country trip with one leg, brief instructor, fly the mission as briefed, and return.*

- (1) Walk-around Inspections at Night
- (2) Night Full Stop Landings
- (3) Landing Light Out Operation
- (4) Night Optical Illusions
- (5) Cockpit Lighting
- (6) Aerial Map Reading and Dead Reckoning at Night
- (7) Aircraft Lighting and Electrical Systems

3. Training Day 13: Night Landing Zone Operations

a. *Simulator Scenario 13: At night, begin at parking, start aircraft, taxi to runway, take off, fly to the landing zone (LZ) training area, conduct specified maneuvers, return to the airport, enter the pattern, execute multiple patterns and landings until complete. Follow prompts to execute the following learning objectives:*

- (1) GPS (Global Positioning System) Navigation
- (2) Night Prepared LZ Operations (Overt Lights)
- (3) Night Emergency Procedures

b. *Flight Lesson 13: Night LZ Operations. At night, fly to the LZ training area and conduct iterative landing training with visible (Overt) Landing Zone lights.*

- (1) GPS (Global Positioning System) Navigation
- (2) Night Prepared LZ Operations (Overt Lights)

- (3) Night Emergency Procedures

4. Training Day 14: Solo Cross-Country Flight

a. Simulator Scenario 14: Given multiple destinations, with no instructor assistance, plan a cross-country trip with three legs, fly the mission in the simulator as briefed, and return. Follow prompts to execute the following learning objectives:

- (1) VOR (VHF Omnidirectional Radio) Navigation
- (2) GPS (Global Positioning System) Navigation
- (3) Aerial Map Reading and Dead Reckoning
- (4) ATC Assistance Available
- (5) En Route Diversions
- (6) Fuel Planning and Fuel Management
- (7) Emergency Procedures

b. Flight Lesson 14: Solo Cross-country. Given multiple destinations, with no instructor assistance, plan a cross-country trip with three legs and brief to the instructor. With no instructor on board, fly the mission as briefed and return.

- (1) GPS (Global Positioning System) Navigation
- (2) Aerial Map Reading and Dead Reckoning
- (3) Fuel Planning and Fuel Management
- (4) Solo Cross Country Flight

5. Training Day 15: STAGE THREE CHECK RIDE

a. Simulator Scenario 15: Stage Three Check Ride Prep. Given multiple destinations, with no instructor assistance, plan a cross-country trip with three legs, fly the mission in the simulator as briefed and return. At least one leg must be initiated one hour after sunset or completed one hour before sunrise. Follow prompts to execute the following learning objectives:

- (1) GPS Navigation
- (2) VOR Navigation
- (3) Aerial Map reading and dead reckoning
- (4) Fuel Planning and Fuel Management
- (5) Military Satellite Communication and tracking
- (6) Night Full Stop Landings
- (7) Cockpit Lighting
- (8) Aircraft Lighting and Electrical Systems

- b. ***Flight Lesson 15: Stage Three Check Ride. Given multiple destinations, with no instructor assistance, plan a cross-country trip with three legs and brief the instructor. Fly the mission as briefed and return. At least one leg must be initiated one hour after sunset or completed one hour before sunrise.***

Test Conditions: Day and Night, Visual Meteorological Conditions (VMC), Wind < 15 knots, Crosswind Component < 10 knots, turbulence moderate or below.

Flight Standards: Conduct safe cross-country flights and perform maneuvers while holding assigned altitude (+/- 150 feet), airspeed (+/- 10 knots), and heading (+/- 10 degrees).

- (1) TASK: GPS Navigation
STANDARDS

Q1: Candidate demonstrates proficiency with the flight planning software and GPS system and navigates to the preplanned destinations.

Q2: Candidate demonstrates familiarity with the flight planning software and GPS system. Candidate may struggle to operate the GPS system, or make small errors that do not affect navigation or safety, but successfully navigates to the preplanned destinations.

Q3: Candidate fails to navigate to the destination.

- (2) TASK: VOR Navigation
STANDARDS

Q1: Candidate demonstrates proficiency with the VOR instruments and uses them appropriately when directed.

Q2: Candidate demonstrates familiarity with the VOR instruments and uses them appropriately when directed. Candidate may struggle to operate the VOR instruments, or make small errors that do not significantly affect navigation or safety, but successfully navigates to the preplanned destinations.

Q3: Candidate fails to navigate to the destination.

- (3) TASK: Aerial Map Reading and Dead Reckoning

STANDARDS

Q1: Candidate follows progress on paper map, and can indicate approximate position (+/- two miles) on a sectional chart upon demand.

Q2: Candidate follows progress on paper map, and can indicate approximate position (+/- five miles) on a sectional chart upon demand.

Q3: Candidate fails to indicate approximate position on a sectional chart upon demand.

(4) TASK: Fuel Planning and Fuel Management

STANDARDS

Q1: Candidate explains and executes proper fuel planning and fuel management and maintains fuel reserves in accordance with the SOAMV Checklist.

Q2: Candidate explains proper fuel planning and fuel management and maintains fuel reserves in accordance with the SOAMV Checklist. Candidate makes minor errors in fuel planning or execution that do not affect safety of flight.

Q3: Candidate makes severe errors in judgment or execution that could lead to improper fuel loading, improper fuel planning, or unsafe fuel management.

(5) TASK: Military Satellite Communication and Tracking

STANDARDS

Q1: Candidate explains MILSATCOM theory and operates military communications equipment in accordance with the SOAMV Checklist.

Q2: Candidate explains MILSATCOM theory and operates military communications equipment with minor variations from the SOAMV Checklist.

Q3: Candidate fails to satisfactorily explain MILSATCOM theory or makes significant errors in operating military communications equipment that would prevent MILSATCOM communication.

(6) TASK: Night Full Stop Landings

STANDARDS

Q1: Candidate maintains the centerline (+/- five feet), maintains appropriate speed throughout the pattern (+/- ten knots), lands in the touchdown area (+/- 500 feet) without excessive impact or pilot induced oscillations, and complies with applicable airport procedures and tower instructions.

Q2: Candidate maintains the centerline (+/- ten feet), maintains appropriate speed throughout the pattern (+/- 15 knots, but never at or below stall speed), lands in the touchdown area (+/- 1,000 feet) with significant impact or minor pilot-induced oscillations, and complies with applicable airport procedures and tower instructions.

Q3: Candidate fails to maintain the centerline (> ten feet), maintains appropriate speed throughout the pattern (>15 knots, or at or below stall speed), fails to land in the touchdown area (>1,000 feet), lands with excessive impact or significant pilot-induced oscillations, or fails to comply with applicable airport procedures and tower instructions.

(7) TASK: Cockpit Lighting Management
STANDARDS

Q1: Candidate arrives prepared for night flight in accordance with the SOAMV Checklist and manages cockpit lighting appropriately.

Q2: Candidate arrives prepared for night flight in accordance with the SOAMV Checklist and manages cockpit lighting appropriately with some prompting.

Q3: Candidate does not have proper equipment for night flight or makes significant errors that could compromise safety of flight.

(8) TASK: Aircraft Lighting and Electrical Systems
STANDARDS

Q1: Candidate configures aircraft lighting systems for night flight in accordance with the SOAMV Checklist and manages lighting appropriately throughout all phases of flight.

Q2: Candidate configures aircraft lighting systems for night flight in accordance with the SOAMV Checklist and manages lighting appropriately with some prompting.

Q3: Candidate makes major errors in lighting configuration that could create hazards to flight.

D. STAGE 4: TACTICAL SKILLS

OBJECTIVE: Learn SOAMV Tactical Skills

TASKS: Night Vision Goggle (NVG) Aided Flight, Unattended Landing Zone Operations

COMPLETION STANDARD: Safely execute NVG Solo Flight

1. Training Day 16: Night Vision Goggle Familiarization

a. *Simulator Scenario 16: Fly to LZ Training Area using NVG (Night Vision Goggle) training devices in the simulator. Follow prompts to execute the following learning objectives:*

- (1) NVG Familiarization
- (2) Depth Perception and associated issues
- (3) NVG Wash-out Mitigation
- (4) Cockpit Management with NVGs
- (5) Landing with NVGs

b. *Flight Lesson 16: Night Vision Goggle Familiarization. With instructor assistance, fly to the LZ training area using NVGs and conduct iterative landing training under reduced light conditions.*

- (1) NVG Familiarization
- (2) Depth Perception and associated issues
- (3) NVG Wash-out Mitigation
- (4) Cockpit Management with NVGs
- (5) Landing with NVGs

2. Training Day 17: Night Vision Goggle Takeoffs and Landings

a. *Simulator Scenario 17: Fly to LZ Training Area using NVG (Night Vision Goggle) training devices in the simulator. Follow prompts to execute the following learning objectives:*

- (1) Depth Perception and associated issues
- (2) NVG Wash-out Mitigation
- (3) Cockpit Management with NVGs
- (4) Landing with NVGs

b. *Flight Lesson 17: Night Vision Goggle Familiarization. With instructor assistance, fly to the LZ training area using NVGs and conduct iterative landing training under reduced light conditions.*

- (1) Depth Perception and associated issues
- (2) NVG Wash-out Mitigation
- (3) Cockpit Management with NVGs
- (4) Landing with NVGs

3. Training Day 18: Night Vision Goggle Cross-Country

a. *Simulator Scenario 18: Given multiple destinations, plan and execute a night cross-country mission in the simulator using the Night Vision Goggle training device. Follow prompts to execute the following learning objectives:*

- (1) Depth Perception and associated issues
- (2) NVG Wash-out Mitigation
- (3) Cockpit Management with NVGs
- (4) GPS Navigation
- (5) Fuel Planning and Management
- (6) Emergency Procedures
- (7) Landing with NVGs

b. *Flight Lesson 18: NVG Cross-Country. Given multiple destinations, plan a night cross-country mission and brief the instructor. Execute as briefed and return. All legs must begin and end during the period one hour after sunset or one hour before sunrise. NVGs should be used during appropriate phases of flight.*

- (1) Depth Perception and associated issues
- (2) NVG Wash-out Mitigation
- (3) Cockpit Management with NVGs
- (4) GPS Navigation
- (5) Emergency Procedures
- (6) Fuel Planning and Management
- (7) Landing with NVGs

4. Training Day 19: Night Vision Goggles & Unattended Landing Zones

a. *Simulator Scenario 19: Given an LZ destination, plan and execute a night cross-country mission to an unmarked LZ in the simulator using the Night Vision Goggle training device. Follow prompts to execute the following learning objectives:*

- (1) Depth Perception and Distance Judgment
- (2) Cockpit Management with NVGs
- (3) GPS Navigation
- (4) Fuel Planning and Management
- (5) Landing with NVGs
- (6) Emergency Procedures
- (7) Unattended LZ Operations

b. *Flight Lesson 19: NVG Unattended LZs. Given an LZ destination, plan a night cross-country mission and brief the*

instructor. Execute as briefed; conduct iterative training at the LZ and return. NVGs should be used during appropriate phases of flight.

- (1) Depth Perception and Distance Judgment
- (2) NVG Wash-out Mitigation
- (3) Cockpit Management with NVGs
- (4) GPS Navigation
- (5) Fuel Planning and Management
- (6) Landing with NVGs
- (7) Unattended LZ Operations (Simulated)

5. Training Day 20: Night Vision Goggle Solo Flight

a. Simulator Scenario 20: Given an LZ destination, plan and execute a night cross-country mission to an marked LZ in the simulator using the Night Vision Goggle training device. Follow prompts to execute the following learning objectives:

- (1) Depth Perception and Distance Judgment
- (2) Cockpit Management with NVGs
- (3) GPS Navigation
- (4) Fuel Planning and Management
- (5) Landing with NVGs
- (6) Controlled LZ Operations

b. Flight Lesson 20: NVG Solo. Given an LZ destination, plan a night mission and brief the instructor. Execute as briefed; conduct iterative training at the LZ and return. NVGs should be used during appropriate phases of flight.

- (1) Depth Perception and Distance Judgment
- (2) NVG Wash-out Mitigation
- (3) Cockpit Management with NVGs
- (4) GPS Navigation
- (5) Fuel Planning and Management
- (6) Landing with NVGs
- (7) Controlled LZ Operations
- (8) Solo NVG Flight

E. STAGE 5: SOAMV EMPLOYMENT

OBJECTIVE: Learn SOAMV Employment Doctrine

TASKS: Formation Flight, Swarming Operations, Unprepared Landing Zone Operations, Opportune Landing Zone Operations, Aircraft Breakdown and Cache Procedures, Heavy-weight Aircraft Techniques

COMPLETION STANDARD: Safely execute tactical mission (Lesson 25), demonstrating good judgment and aeronautical decision-making while completing all graded portions of the mission.

1. Training Day 21: Formation Flight (2 Ship)

a. Simulator Scenario 21: Given mission criteria, plan a mission with two other students and execute the mission in networked simulators. Follow prompts to execute the following learning objectives:

- (1) Formation Departures
- (2) Formation Arrivals
- (3) Extended Trail Formation
- (4) Swarm Arrivals
- (5) Swarm Departures
- (6) Rejoin Procedures

b. Flight Lesson 21: Formation Flight. With Instructor assistance, plan a flight with one other student and one instructor. Follow the instructor's guidance to execute the following learning objectives:

- (1) Formation Departures
- (2) Formation Arrivals
- (3) Extended Trail Formation
- (4) Swarm Arrivals
- (5) Swarm Departures
- (6) Rejoin Procedures

2. Training Day 22: Formation Departures and Arrivals (4-Ship)

a. Simulator Scenario 22: Given mission criteria, plan a mission with three other students and execute the mission in networked simulators. Follow prompts to execute the following learning objectives:

- (1) Formation Departures
- (2) Formation Arrivals
- (3) Extended Trail Formation
- (4) Swarm Arrivals
- (5) Swarm Departures
- (6) Rejoin Procedures

- b. Flight Lesson 22: Formation Flight. With minimal instructor assistance, plan a flight with three other students and one instructor observing. Follow the mission template to execute the following learning objectives:***

- (1) Formation Departures
- (2) Formation Arrivals
- (3) Extended Trail Formation
- (4) Swarm Arrivals
- (5) Swarm Departures
- (6) Rejoin Procedures

3. Training Day 23: Formation Flight & Opportune LZ

- a. Simulator Scenario 23: Given mission criteria, plan a mission with three other students and execute the mission in networked simulators. Follow prompts to execute the following learning objectives:***

- (1) Swarm Departures
- (2) Swarm Arrivals
- (3) Rejoin Procedures
- (4) Opportune LZ Selection and Operation
- (5) Swarm Arrivals at Opportune LZs

- b. Flight Lesson 23: Formation Flight to Opportune LZ. With minimal instructor assistance, plan a flight with three other students and one instructor observing. Follow the mission template to execute the following learning objectives:***

- (1) Swarm Departures
- (2) Swarm Arrivals
- (3) Rejoin Procedures
- (4) Opportune LZ Selection and Operation
- (5) Swarm Arrivals at Opportune LZs

4. Training Day 24: Formation Flights & Landing Zones (4 Ship)

- a. Simulator Scenario 24: Given mission criteria, plan a night mission with three other students and execute the mission in networked simulators. Follow prompts to execute the following learning objectives:***

- (1) Swarm Departures
- (2) Extended Trail Formation
- (3) Rejoin Procedures

- (4) Cockpit Management with NVGs
- (5) GPS Navigation
- (6) Fuel Planning and Management
- (7) Landing with NVGs
- (8) Swarm Arrivals at Controlled LZs.

b. Flight Lesson 24: Formation Flight. With minimal instructor assistance, plan a flight with three other students and one instructor observing. Follow the mission template to execute the following learning objectives:

- (1) Swarm Departures
- (2) Extended Trail Formation
- (3) Rejoin Procedures
- (4) Cockpit Management with NVGs
- (5) GPS Navigation
- (6) Fuel Planning and Management
- (7) Landing with NVGs
- (8) Swarm Arrivals at Controlled LZs.

5. Training Day 25: Night Formation Flight (4 Ship)

a. Simulator Scenario 25: Given mission criteria, plan a night mission with three other students and execute the mission in networked simulators. Follow prompts to execute the following learning objectives embedded in a tactical scenario.

- (1) Swarm Departures
- (2) Extended Trail Formation
- (3) Rejoin Procedures
- (4) Cockpit Management with NVGs
- (5) GPS Navigation
- (6) Fuel Planning and Management
- (7) Loading, Weight, and Balance
- (8) Aeronautical Decision Making
- (9) Risk Management
- (10) Landing with NVGs
- (11) Swarm Arrivals at Controlled LZs.

b. Flight Lesson 25: Tactical Exercise. With no instructor assistance, plan a flight with three other students and one

instructor observing. Follow the mission template to execute the following learning objectives:

- (1) Swarm Departures
- (2) Extended Trail Formation
- (3) Rejoin Procedures
- (4) Cockpit Management with NVGs
- (5) GPS Navigation
- (6) Fuel Planning and Management
- (7) Landing with NVGs
- (8) Swarm Arrivals at Controlled LZs
- (9) Loading, Weight, and Balance
- (10) Aeronautical Decision Making
- (11) Risk Management

F. STAGE 6: SOAMV DEPLOYMENT

OBJECTIVE: Learn to utilize SOAMV Tactical Skills in a full mission profile

TASKS: Mission Planning. Long-distance Ferrying: Configuration and Practice. SOAMV Break-down, Build-up, Palletize, Containerize. SOAMV Cache Procedures. International Airspace System. Surface to Air Threats. Air-to-Air Threats. USAF Integration

COMPLETION STANDARD: SOAMV Operator Validation Exercise (SOVE)

1. Training Day 26A: Aircraft Assembly, Disassembly, and Cache

a. Simulator Scenario 26A: Given mission criteria, plan a night mission with three other students and execute the mission in networked simulators. Follow prompts to execute the following learning objectives embedded in a tactical scenario.

- (1) Mission Planning
- (2) Surface-to-Air Threats
- (3) Air-to-Air Threats
- (4) USAF Integration
- (5) Aeronautical Decision Making
- (6) Risk Management
- (7) NVG Use

b. Flight Lesson 26A: Aircraft Assembly/Disassembly. With instructor and maintainer assistance, break down SOAMV aircraft for transport; reassemble; and assist maintainers with airworthiness checks. Conduct Flight Check with instructor.

- (1) SOAMV Breakdown

- (2) Palletize SOAMV
- (3) Containerize SOAMV
- (4) Reassemble SOAMV
- (5) Install Auxiliary Fuel Tanks with Assistance
- (6) Assist Maintainers in Airworthiness Check
- (7) Conduct Flight Check with Instructor
- (8) Remove Ferry Kit with Assistance

2. Training Day 26B: Flight Envelope Awareness

a. *Simulator Scenario 26B: Fly a tactical mission profile to a given landing zone with varying aircraft configurations. Follow prompts to execute the following learning objectives:*

- (1) Center of Gravity Out of Limits
- (2) Overweight Aircraft
- (3) Unbalanced Loading
- (4) Bulky Load
- (5) High Density Altitude
- (6) Sloping LZs
- (7) Wind Out of Limits
- (8) Crosswind Out of Limits
- (9) Severe Turbulence

b. *Flight Lesson 23B: Flight Envelope Awareness. With direct instructor assistance, load a SOAMV to different weights and different configurations to experience flight characteristics near the operational envelope.*

- (1) Center of Gravity Near Operational Limits
- (2) Aircraft Near Max Gross Weight
- (3) Bulky Load (as applicable for external stores)
- (4) Laterally Unbalanced Load (within operational limits)
- (5) Sloping LZs

3. Training Day 27: Full Mission Profile 1–Insert the Force

a. *Simulator Scenario 27: Given mission criteria, plan a night infiltration mission with seven other students and execute the mission in networked simulators. Follow prompts to execute the following learning objectives embedded in a tactical scenario.*

- (1) Mission Planning
- (2) Surface-to-Air Threats

- (3) Air-to-Air Threats
- (4) USAF Integration
- (5) Combat Search and Rescue
- (6) Downed aircraft procedures
- (7) Aeronautical Decision Making
- (8) Risk Management

b. Flight Lesson 27: Full Mission Profile 1—Insert the Force. Given a complete scenario, with minimal instructor assistance, plan and execute a mock infiltration mission with seven other students.

- (1) Mission Planning
- (2) Surface-to-Air Threats (Simulated)
- (3) USAF Integration (Simulated)
- (4) Downed aircraft procedures (Simulated)
- (5) Aeronautical Decision Making
- (6) Risk Management
- (7) SOAMV Cache Procedures

4. Training Day 28: Full Mission Profile 2—Extract the Force

a. Simulator Scenario 28: Given mission criteria, plan a night exfiltration mission with seven other students and execute the mission in networked simulators. Follow prompts to execute the following learning objectives embedded in a tactical scenario.

- (1) Mission Planning
- (2) Surface-to-Air Threats
- (3) Air-to-Air Threats
- (4) USAF Integration
- (5) Swarm Departures
- (6) Swarm Arrivals
- (7) GPS Navigation
- (8) Aeronautical Decision Making
- (9) Risk Management

b. Flight Lesson 28: Full Mission Profile 2—Extract the force. Given a complete scenario, with minimal instructor assistance, plan and execute a mock exfiltration mission with seven other students.

- (1) Mission Planning
- (2) Surface-to-Air Threats
- (3) Air-to-Air Threats
- (4) USAF Integration

- (5) Swarm Departures
- (6) Swarm Arrivals
- (7) GPS Navigation
- (8) Aeronautical Decision Making
- (9) Loading, Weight, and Balance
- (10) Risk Management

5. Training Day 29: Full Mission Profile 3—Combat Search & Rescue

- a. Simulator Scenario 29: Given mission criteria, plan a night Combat Search and Rescue (CSAR) mission with three other students and execute the mission in networked simulators. Follow prompts to execute the following learning objectives embedded in a tactical scenario.*

- (1) Mission Planning
- (2) Surface-to-Air Threats
- (3) Air-to-Air Threats
- (4) Aerial Search Techniques
- (5) CSAR Task Force Integration
- (6) GPS Navigation
- (7) Aeronautical Decision Making
- (8) Risk Management

- b. Flight Lesson 29: Full Mission Profile Three–CSAR. Given a complete scenario, with minimal instructor assistance, plan and execute a mock CSAR mission with three other students.*

- (1) Mission Planning
- (2) Surface-to-Air Threats
- (3) Air-to-Air Threats
- (4) Aerial Search Techniques
- (5) CSAR Task Force Integration
- (6) GPS Navigation
- (7) Aeronautical Decision Making
- (8) Risk Management

6. Training Day 30: SOAMV Operator Validation Exercise

- a. SOAMV Operator Validation Exercise: Simulator*
Given mission criteria, plan a mission with seven other students and execute the mission in networked simulators. This simulated exercise must be executed to standard BOTH individually and as an eight-ship formation in order to progress

to the practical test. Follow prompts to execute the SOVE Simulator Test Standards embedded in the tactical scenario.

- (1) Mission Planning
- (2) Air-to-Air and Ground-to-Air Threat Mitigation
- (3) Swarm Departures and Arrivals
- (4) SOAMV Cache
- (5) Loading, Weight, and Balance
- (6) Aeronautical Decision Making
- (7) Cockpit Lighting Management
- (8) Aircraft Lighting and Electrical Systems

b. SOAMV Operator Validation Exercise: Practical

The SOVE is a full-mission-profile exercise designed to test each candidate's tactical execution under realistic conditions. Each candidate must pass the scenario in the simulator before attempting the test in the aircraft. During the simulator event each student will be graded individually; during the live flight event they will be graded both individually and as a flight (8-ship formation). Instructors will accompany each candidate for the purpose of grading only, but will not interfere with the scenario except for safety of flight. Major safety violations (as defined in the SOAMV Checklist) will be cause for immediate termination of the exercise ("knock-it-off") and exercise failure. One re-test may be granted at the discretion of the Commander, SOAMV Training Center.

**(1) TASK: Mission Planning
STANDARDS**

Q1: Candidate produces optimized mission plan that appropriately addresses tactical considerations and logistics requirements.

Q2: Candidate produces feasible mission plan that adequately addresses tactical considerations and logistics requirements. Candidate may make small errors that do not affect mission accomplishment or safety.

Q3: Candidate fails to produce a feasible plan.

**(2) TASK: Air-to-Air and Ground-to-Air Threat Mitigation
STANDARDS**

Q1: Candidate produces optimized threat mitigation plan that appropriately addresses the given threats.

Q2: Candidate produces feasible threat mitigation plan that adequately addresses given threats. Candidate may make small errors that do not affect mission accomplishment or safety.

Q3: Candidate fails to produce a feasible threat mitigation plan.

(3) TASK: Swarm Departures and Arrivals
STANDARDS

Q1: Candidate executes swarm arrival and departure procedures in accordance with the SOAMV Checklist. Candidates must meet arrival contracts +/- 30 seconds.

Q2: Candidate executes swarm arrival and departure procedures in accordance with the SOAMV Checklist. Candidates must meet arrival contracts +/- 90 seconds.

Q3: Candidate fails to execute swarm arrival or departure procedures in accordance with the SOAMV Checklist or misses arrival contracts by greater than 90 seconds.

(4) TASK: SOAMV Cache
STANDARDS

Q1: Candidate executes SOAMV Cache procedures in accordance with the SOAMV Checklist. Candidates complete all checklist items correctly in less than 10 minutes.

Q2: Candidate executes SOAMV Cache procedures in accordance with the SOAMV Checklist. Candidates may make small errors while completing checklist items. These errors cannot interfere with safety of flight. Candidates will complete all checklist items correctly in less than 20 minutes.

Q3: Candidate executes major deviations from SOAMV Cache procedures in the SOAMV Checklist or induces errors that could interfere with safety of flight. Candidates fail to complete all checklist items correctly in less than 20 minutes.

(5) TASK: Loading, Weight, and Balance
STANDARDS

Q1: Given mission equipment and/or personnel to transport, candidate configures and secures load in SOAMV and calculates accurate weight and balance.

Q2: Candidate configures and secures load in SOAMV with minor variations from the SOMAV

Checklist or make minor errors while calculating accurate weight and balance. No errors may threaten safety of flight.

Q3: Candidate fails to configure or secure load in SOAMV in accordance with the SOMAV Checklist or makes significant errors while calculating accurate weight and balance that may threaten safety of flight.

(6) TASK: Aeronautical Decision Making
STANDARDS

Q1: Candidate responds optimally to given prompts, including weather decisions, go/no-go decisions, threat mitigation decisions, simulated emergencies, and/or tactical inputs included in the scenario. Candidate exhibits clear ability to balance mission accomplishment and safety considerations. Candidate can clearly articulate rationale for decisions.

Q2: Candidate responds appropriately to given prompts including weather decisions, go/no-go decisions, threat mitigation decisions, simulated emergencies, and/or tactical inputs included in the scenario. Candidate exhibits ability to balance mission accomplishment and safety considerations. Candidate can generally articulate rationale for decisions.

Q3: Candidate demonstrates flawed decision-making processes or introduces unsafe/unfeasible solutions.

(7) TASK: Cockpit Lighting Management
STANDARDS

Q1: Candidate arrives prepared for night flight in accordance with the SOAMV Checklist and manages cockpit lighting appropriately.

Q2: Candidate arrives prepared for night flight in accordance with the SOAMV Checklist and manages cockpit lighting appropriately with some prompting.

Q3: Candidate does not have proper equipment for night flight or makes significant errors that could compromise safety of flight.

(8) TASK: Aircraft Lighting and Electrical Systems
STANDARDS

Q1: Candidate configures aircraft lighting systems for night flight in accordance with the SOAMV Checklist and manages lighting appropriately throughout all phases of flight.

Q2: Candidate configures aircraft lighting systems for night flight in accordance with the SOAMV Checklist and manages lighting appropriately with some prompting.

Q3: Candidate makes major errors in lighting configuration that could create hazards to flight.

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LIST OF REFERENCES

- Air Force Special Operations Command. "Special Tactics." Accessed November 9, 2013.
<http://www.afsoc.af.mil/specialtactics>.
- American Society for Testing and Materials, International. "ASTM Fact Sheet."
November 2013. Accessed November 20, 2013.
<http://www.astm.org/ABOUT/factsheet.html>.
- Arquilla, John, and David Ronfeldt. *Swarming and the Future of Conflict*. Santa Monica, CA: RAND Corporation, 2000.
- Croft, John. "Updated Part 23 Rules To Revive Four-Seat GA Market." *Aviation Week and Space Technology*. July 29, 2013.
- Cub Crafters Corporation. "Gallery." Accessed November 10, 2013.
http://www.cubcrafters.com/images/media/ccss_amphibs_01.jpg.
- Deneer, Sarah. "Small airplane lands on cargo ship, cameras rolling." *Aircraft Owners and Pilot's Association Magazine*, November 7, 2013. Accessed November 7, 2013. http://www.aopa.org/News-and-Video/All-News/2013/November/07/cargo-ship-landing.aspx?WT.mc_sect=tts&WT.mc_id=131108epilot.
- 5500 Feet Flight Training. "Sport Pilot." Accessed July 27, 2013.
<http://www.5500feet.com>.
- Gleim Knowledge Transfer Systems. "Private Pilot Training Program." Accessed May 5, 2013. <http://www.gleim.com>.
- Goyer, Robert. "Part 23: Time for a Change." *Flying Magazine*. Apr 27, 2013.
<http://www.flyingmag.com/pilots-places/pilots-adventures-more/part-23-time-change#LwT0i09eTI5Muffg.99>.
- Icon Aircraft, LLC. "Icon A5." Accessed November 12, 2013.
<http://www.iconaircraft.com>.
- Jabiru USA, Incorporated. "J-230." Accessed Jun 1, 2013. <http://JabiruUSA.com>.
- Jack Brown's Seaplane Base. "Single Engine Sea Course." Accessed November 1, 2013.
<http://brownsseaplane.com>.
- Jackson, Paul, ed. "Jane's All the World's Aircraft." *Jane's Defence*, 2013.
- Jeppesen, a Boeing Company. "Private Pilot Kit." Accessed November 1, 2013,
<http://www.jeppesen.com>.

- Just Aircraft Company. "Highlander STOL." Accessed October 1, 2013.
<http://www.justaircraft.com>.
- Kenney, David. "Air Mobility Vehicles: Special Operations' Answer to Opposed Access." Master's thesis, Naval Postgraduate School, 2012.
- King Schools. "Private Pilot Course." Accessed November 1, 2013.
<http://www.kingschools.com>.
- Multi Mission, LLC. "Multi Mission Aircraft." Accessed June 1, 2013.
<http://multimissionllc.com>.
- North Wing Corporation. "Scout XC." Accessed October 15, 2013.
<http://www.northwing.com>.
- ParaJet Corporation. "SkyRunner." Accessed November 1, 2013. <http://www.fly-skyrunner.com>.
- Redbird Skyport. "Private Pilot." Accessed November 9, 2013.
<http://www.redbirdskyport.com>.
- Society of Aviation and Flight Educators. "Sport Pilot Syllabus." Accessed May 10, 2013.
- Turner, Thomas. "Is The LSA Safe?" *Aviation Safety Magazine*. August 2012. Accessed June 5, 2013. http://www.aviationsafetymagazine.com/issues/32_8/features/is-the-lsa-safe_10334-1.html.
- Twombly, Ian. "Big Idea." *Flight Training Magazine*. January 2013.
- United States Department of Defense. United States Air Force. Irregular Warfare Strategy. 2013.
- . Quadrennial Defense Review Report. February 2010.
- United States Department of Transportation, Federal Aviation Administration December 2004. FAA-S-8081-29 SPORT PILOT Practical Test Standards.
- . Calendar Year 2010 General Aviation Statistics. Accessed May 10, 2013.
http://www.faa.gov/data_research/aviation_data_statistics/general_aviation/CY2010/.
- . "Student Pilot Certificate Procedures and Sport Pilot Endorsements." March 2010. Accessed June 3, 2013.
http://www.faa.gov/licenses_certificates/airmen_certification/sport_pilot/media/student_pilot%20guidance.pdf.

United States National Archives and Records Administration. 2008. Code of federal regulations. Title 14. Aeronautics and Space.

Week, Martin W., and Walter M. Winter. "Special operations forces aviation on a shoestring budget: an effectiveness analysis of light and medium fixed wing aircraft." Master's thesis, Naval Postgraduate School, 2012.

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